# STUDIES ON MARINE BRYOZOA, III. WOODS HOLE REGION BRYOZOA ASSOCIATED WITH ALGAE

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## Introduction

Heretofore there has been no extensive study made of the association between bryozoa and algae, except for the studies by Joliet (1877) and Prenant and Teissier (1924, 1927, 1932), although incidental association notes are scattered throughout taxonomic papers.

The purposes of the present study are several: (1) to note any association that may exist between algae and certain bryozoa (bryozoa likely to be encountered in the Woods Hole region); (2) to aid collectors of bryozoa, since in some instances by collecting specified algae one is almost sure to find a number of desired bryozoa; (3) to make any observations possible on the tentacle number, the occurrence of embryos, larvae and ovicells in specimens collected during the summer months, and (4) to report any additional species from the collection area.

## Collection Data

The materials used in this study were marine algae of three general groups: (1) freshly collected specimens; (2) dry, pressed specimens mounted at various times in the past on herbarium sheets; and (3) specimens preserved in the Botany Course Stock Collection of the Marine Biological Laboratory (M. B. L.) of Woods Hole, Mass. More species were examined than are here recorded but only those 37 algal species which had bryozoa growing on them are here listed.

Some of the fresh material was obtained in the intertidal zone by shore collecting; some had drifted in from deeper waters some distance from shore; and some had been dredged with a scallop dredge from waters about 20 to 60 feet in depth.

Some of the material was collected by the authors, some by the M. B. L. Invertebrate Zoology and Botany classes on their field trips, some by the M. B. L. Supply Department and Collecting Crew, and one algal species by Dr. Maxwell Doty of Northwestern University. To all these the authors wish to express their most sincere appreciation, and especially to Dr. William Randolph Taylor of the University of Michigan for very helpful suggestions, continued kindly interest, and for specimens of *Membranipora tuberculata* and their algal hosts from his own collection.

The *Laminaria longicruris* was brought in by Dr. Doty from Race Point, near Provincetown, Mass. on VIII–18–1947. The Rye Ledge, Rye, New Hampshire specimens of *Chondrus crispus, Phycodrys rubens* and *Phyllophora membranifolia* were collected by the junior author on IX–30–1945. The New Rochelle, New York specimens of *Ascophyllum nodosum, Ascophyllum Mackaii, Chondrus crispus* and *Laminaria Agardhii* were observed on IX–16 and 22–1945, and on X–3–1946 by the senior author. The remainder of the specimens were collected in the waters around and between North Falmouth, Martha's Vineyard, Woods Hole, Vineyard Sound, Buzzards Bay, Penikese Island and New Bedford, all in Massachusetts, during the summer months, between June 30 and August 31 approximately, over a period of several years (Sept. 1874, 1916, 1930, 1935, 1936, 1938, 1939, 1944 through 1947). Specimens from the five earliest years came from the M. B. L. Botanical Collection, some from wet mounts and some from dried herbarium mounts. Exact records, dates and collection numbers of all these algal specimens are on file, but only a very condensed amount of these data is included in Tables I to IV, to save space.

The senior author identified the bryozoa, the junior author classified the algae and collected many of them.

TABLE I

*Collection sites and bryozoa associated with green algae*

| | *Cladophora gracilis* f. *tenuis* | *Enteromorpha intestinalis* | *Ulva Lactuca* var. *rigida* | Total No. green algae having this bryozoan species |
|---|---|---|---|---|
| *Bowerbankia gracilis* | | x | x | 2 |
| *Bugula turrita* | x | x | x | 3 |
| *Cryptosula pallasiana* | | x | x | 2 |
| *Flustrella hispida* | | | x | 1 |
| *Pedicellina cernua* | x | | | 1 |
| Total No. bryozoan spp. on this alga | 2 | 3 | 4 | |
| Collected at Woods Hole, Mass. | x | x | x | |

To date there have been reported 84 species of marine bryozoa from the Woods Hole region, by Osburn (1912) mostly, and by Rogick (1945a, 1948). Some of the Woods Hole species have been previously reported from such widely separated regions as the coast of Africa, Australia, the Azores, Brazil, Denmark, Great Britain, Japan, New Zealand, Panama, Zanzibar, and the Pacific coast of North America. These were reported from various substrates as shells, rocks, hydroids, algae, various animals, piles, and other submerged objects. The present study was mainly directed toward finding the exact algal species on which bryozoa grow. Previous reports from the Woods Hole region occasionally did indicate the algal genera but rarely the species on which the bryozoa occurred. The following lists of algae and bryozoa are of species collected or examined for the present paper.

Below follows a list of 37 algae on which were commonly found various bryozoans. Taylor's (1937) classification is used.

TABLE II

*Collection sites and bryozoa associated with brown algae*

| | *Ascophyllum Mackaii* | *Ascophyllum nodosum* | *Chorda Filum* | *Cladostephus verticillatus* | *Desmarestia aculeata* | *Fucus evanescens* | *Fucus vesiculosus* | *F. vesiculosus spiralis* | *Laminaria Agardhii* | *Laminaria longicruris* | *Sargassum Filipendula* | Total No. brown algal spp. associated with this bryozoan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Aetea sica* | | x | x | x | | | x | x | x | | x | 7 |
| *Aeverrillia armata* | | | | | | | | | x | | | 1 |
| *Aeverrillia setigera* | | x | | | | | | | x | | x | 3 |
| *Alcyonidium polyoum* | | | | | | | | | x | x | | 2 |
| *Bowerbankia gracilis* | | x | x | x | | | x | x | | | x | 6 |
| *Bowerbankia imbricata* | | | | | | | x | | x | | x | 3 |
| *Bugula cucullifera* | | | | | | x | | | | x | | 2 |
| *Bugula flabellata* | | | | | | | x | | | | | 1 |
| *Bugula turrita* | | x | x | | | | x | x | x | | x | 6 |
| *Callopora aurita* | | | | | | | | | x | | | 1 |
| *Cribrilina punctata* | | | | | | | | | x | | | 1 |
| *Crisia eburnea* | | x | | | x | | | | x | | x | 4 |
| *Cryptosula pallasiana* | x | x | | | | | | x | x | | | 4 |
| *Electra hastingsae* | | | | | | | | x | x | | | 2 |
| *Electra pilosa* | | x | | | x | x | | x | x | x | x | 7 |
| *Flustrella hispida* | | x | | | | | x | | | | | 2 |
| *Hippothoa hyalina* | | x | | | | | | x | x | | x | 4 |
| *Membranipora lacroixii*(?) | x | | | | | | | | | | | 1 |
| *Microporella ciliata* | | | | | | | | | x | | | 1 |
| *Pedicellina cernua* | | x | | | | | x | | x | | | 3 |
| *Schizoporella biaperta* | | | | | x | | | | x | | | 2 |
| *Schizoporella unicornis* | | | | | | | | x | x | | | 2 |
| *Scruparia ambigua* | | | | | x | x | | | x | | | 3 |
| *Scruparia clavata* | | | | | | | | | x | | | 1 |
| *Smittina trispinosa* | | | | | | | | | x | | | 1 |
| Total No. bryozoan spp. found on this alga | 2 | 10 | 3 | 2 | 4 | 3 | 7 | 8 | 20 | 3 | 8 | |
| Collected at Woods Hole | | x | x | x | | | x | x | x | | x | |
| Collected at North Falmouth | | x | | | | | | x | | | x | |
| Collected in Vineyard Sound | | | x | | x | x | | | | | x | |
| Collected at Martha's Vineyard | | | | | x | x | x | | x | | | |
| Collected at Penikese Island | | | | | | | | x | | | | |
| Collected at Provincetown | | | | | | | | | | x | | |
| Collected at New Rochelle | x | x | | | | | | | x | | | |

## TABLE III

*Collection sites and bryozoa associated with red algae*

| | *Agardhiella tenera* | *Callithamnion roseum* | *Ceramium rubriforme* | *Ceramium rubrum* | *Champia parvula* | *Chondrus crispus* | *Corallina officinalis* | *Cryptopleura* sp. | *Cystoclonium purpureum cirrhosum* | *Gracilaria confervoides* | *Gracilaria foliifera* | *Lithothamnium* sp. | *Phycodrys rubens* | *Phyllophora Brodiaei* | *Phyllophora membranifolia* | *Plumaria sericea* | *Polyides rotundus* | *Polysiphonia elongata* | *Polysiphonia nigra* | *Polysiphonia nigrescens* | *Polysiphonia variegata* | *Rhodomela subfusca* | *Rhodymenia palmata* | Total No. red algal spp. associated with this bryozoan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Aetea sica* | | | | x | | x | | | x | x | | x | x | x | x | | | | | x | x | x | | 11 |
| *Aeverrillia armata* | | | | | | | | | | | | | | | x | | | | | | | | | 1 |
| *Aeverrillia setigera* | | | | | x | x | | | | | | | | | x | | | | | x | | x | | 5 |
| *Alcyonidium polyoum* | | | | | | x | | | | | | | | x | x | | | | | | | | | 3 |
| *Bowerbankia gracilis* | x | | | x | x | x | x | | x | | x | | | x | x | | | | | x | | | | 10 |
| *Bowerbankia imbricata* | | | | | | x | | | | | x | | | | | | | | | | | | | 2 |
| *Bugula cucullifera* | | | | | | | | | | | | | | | x | | | | | | | | x | 2 |
| *Bugula turrita* | | | | | | x | | | x | | | | x | x | x | | x | | | x | | | | 7 |
| *Callopora aurita* | | | | | | | | | | | | | x | | x | | | | | | | | | 2 |
| *Cellepora dichotoma* | | | | | | x | | | | x | | | | x | x | | | | | | | | | 4 |
| *Cribrilina annulata* | | | | | | | | | | | | | x | | | | | | | | | | | 1 |
| *Cribrilina punctata* | | | | | | x | | | | | | | x | x | x | | | | | | x | | x | 6 |
| *Crisia eburnea* | | | | x | x | x | x | | x | x | | | x | x | x | x | | | x | x | x | | x | 14 |
| *Cryptosula pallasiana* | | | | | | x | | | x | | | | | x | x | | | | | | x | | | 5 |
| *Electra pilosa* | | | | | | x | | | x | | | | x | x | x | x | | | x | | x | x | x | 10 |
| *Flustrella hispida* | | | | | | x | | | | | | | | | x | | | | | | | | | 2 |
| *Hippoporina contracta* | | | | | | | | | | | | | | x | x | | | | | | | | | 2 |
| *Hippothoa hyalina* | | | | x | | x | x | | x | x | | | x | x | x | | x | x | | | x | x | x | 13 |
| *Lichenopora hispida* | | | | | | | | | | | | | x | | x | | | | | | | | | 2 |
| *Membranipora lacroixii*(?) | | | | | | x | | | | | | | | | x | | | | | | | | | 2 |

TABLE III—*Continued*

| | *Agardhiella tenera* | *Callithamnion roseum* | *Ceramium rubriforme* | *Ceramium rubrum* | *Champia parvula* | *Chondrus crispus* | *Corallina officinalis* | *Cryptopleura* sp. | *Cystoclonium purpureum cirrhosum* | *Gracilaria confervoides* | *Gracilaria foliifera* | *Lithothamnium* sp. | *Phycodrys rubens* | *Phyllophora Brodiaei* | *Phyllophora membranifolia* | *Plumaria sericea* | *Polyides rotundus* | *Polysiphonia elongata* | *Polysiphonia nigra* | *Polysiphonia nigrescens* | *Polysiphonia variegata* | *Rhodomela subfusca* | *Rhodymenia palmata* | Total No. red algal spp. associated with this bryozoan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Membranipora tuberculata* | | | | | | | | x | | | | | | | | | | | | | | | | 1 |
| *Microporella ciliata* | | | | | | x | | | | | | | | x | x | | | | | | | | | 4 |
| *Pedicellina cernua* | | | | | | x | | | x | | x | | | x | x | | | | | x | x | | x | 7 |
| *Schizoporella biaperta* | | | | | | x | x | | x | | | | x | x | x | | | | | x | | | | 7 |
| *Schizoporella unicornis* | | | | | | x | | | x | | | | | | x | | | | | | | | x | 4 |
| *Scruparia ambigua* | | x | x | x | | x | | | x | | | | | | | x | | | x | | x | | | 8 |
| *Smittina trispinosa* | | | | | | x | | | | | | | | x | x | | | | | | | | | 3 |
| Total No. bryozoan spp. on this alga | 1 | 1 | 1 | 5 | 3 | 20 | 4 | 1 | 11 | 4 | 3 | 1 | 10 | 15 | 23 | 3 | 2 | 1 | 3 | 7 | 8 | 4 | 7 | |
| Collected at Woods Hole | x | | | x | x | x | | | | x | x | x | | x | x | | | | | x | x | x | | |
| Collected at Martha's Vineyard | | x | x | x | | x | x | | x | | | | x | x | | x | x | x | x | | x | | x | |
| Collected in Vineyard Sound | | | | x | | | | | | | | | | | x | | | | | | | | x | |
| Collected at North Falmouth | | | | | | x | | | x | | | | | | | | | | | x | | x | | |
| Collected on Penikese Island | | | | | | x | | | | | | | | | | | | | | | | | | |
| Collected at New Bedford | x | | | | | | | | | | | | | | x | | | | | x | | | | |
| Collected at New Rochelle | | | | | | x | | | | | | | | | | | | | | | | | | |
| Collected at Rye, N. H. | | | | | | x | | | | | | | x | | x | | | | | | | | | |
| From Puerto de la Paloma, Uruguay* | | | | | | | | x | | | | | | | | | | | | | | | | |

* Specimens sent by Dr. W. R. Taylor.

## TABLE IV

*Collection sites and other Bryozoan data*

| | Penikese Island, Mass. | New Bedford, Mass. | North Falmouth, Mass. | Vineyard Sound, Mass. | Martha's Vineyard, Mass. | Woods Hole, Mass. | New Rochelle, New York | Rye, New Hampshire | Provincetown, Mass. | Puerto de la Paloma, Uruguay | No. of algal spp. from which bryozoan was reported in Tables I, II, III | Partial list of the No. of algal spp. or genera from which this bryozoan was reported by other workers. See under each bryozoan species discussion | Tentacle number. Personal observations unstarred, others starred | In filled-oviceil, embryo-producing or larva-releasing stage at Woods Hole |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. *Aetea sica* | | | x | x | x | x | | | | | 18 | | 9–11 | July 30–Aug. 6± |
| 2. *Aeverrillia armata* | | x | | | x | | | | | | 2 | | 8 | |
| 3. *Aeverrillia setigera* | | x | | | | x | | | | | 8 | | 8 | |
| 4. *Alcyonidium polyoum* | | x | | | | x | x | | x | | 5 | 5 | 16, 20* | |
| 5. *Bowerbankia gracilis* | | x | x | x | x | x | | | | | 18 | | 8 | |
| 6. *Bowerbankia imbricata* | | | | | x | x | x | | | | 5 | 6 | 10 | All of Aug.± |
| 7. *Bugula cucullifera* | | x | | x | | | | | x | | 4 | | 13 | Aug. 1–18 ± |
| 8. *Bugula flabellata* | | | | | x | | | | | | 1 | | | June 1–Nov. 15 |
| 9. *Bugula turrita* | | | x | x | x | x | | | | | 16 | | 14 | June 30–Aug. 15± |
| 10. *Callopora aurita* | | | | | x | x | | x | | | 3 | | | |
| 11. *Cellepora dichotoma* | | | | | x | x | | | | | 4 | | | July 25± |
| 12. *Cribrilina annulata* | | | | | | | | x | | | 1 | 1 | | |
| 13. *Cribrilina punctata* | x | | | | x | x | | x | | | 7 | | | |
| 14. *Crisia eburnea* | | x | x | x | x | x | | x | | | 18 | 2 | 8* | Aug. 8± |
| 15. *Cryptosula pallasiana* | | | x | | x | x | x | | | | 11 | 4 | 16 | June–Sept.± |

TABLE IV—*Continued*

| | Penikese Island, Mass. | New Bedford, Mass. | North Falmouth, Mass. | Vineyard Sound, Mass. | Martha's Vineyard, Mass. | Woods Hole, Mass. | New Rochelle, New York | Rye, New Hampshire | Provincetown, Mass. | Puerto de la Paloma, Uruguay | No. of algal spp. from which bryozoan was reported in Tables I, II, III | Partial list of the No. of algal spp. or genera from which this bryozoan was reported by other workers. See under each bryozoan species discussion | Tentacle number. Personal observations unstarred, others starred | In filled-ovicell, embryo-producing or larva-releasing stage at Woods Hole |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16. *Electra hastingsae* | | | | | | x | x | | | | 2 | 1 | | |
| 17. *Electra pilosa* | x | x | x | x | x | x | x | x | x | | 17 | 8 | 12–14 | |
| 18. *Flustrella hispida* | | | | | | x | | | | | 5 | 3 | 13 | |
| 19. *Hippoporina contracta* | | | | | | x | | | | | 2 | | 12* | |
| 20. *Hippothoa hyalina* | x | x | x | x | x | x | | x | | | 17 | 5 | 12*–14* | July–Aug.± |
| 21. *Lichenopora hispida* | | | | | | | | x | | | 2 | | | |
| 22. *Membranipora lacroixii*(?) | | | | | | | x | | | | 3 | | 11 | |
| 23. *Membranipora tuberculata* | | | | | | | | | | x | 1 | 3 | | |
| 24. *Microporella ciliata* | | | | | x | x | | | | | 5 | 3 | 13*–14* | Aug.± |
| 25. *Pedicellina cernua* | | x | x | x | x | x | x | | | | 11 | 6 | 8–12; 8*–24* | |
| 26. *Schizoporella biaperta* | | | x | | x | x | | | | | 9 | | 12 | July–Aug.± |
| 27. *Schizoporella unicornis* | | x | x | | x | x | | | | | 6 | 3 | about 18* | July–Aug.± |
| 28. *Scruparia ambigua* | | | x | | x | | | | | | 11 | | 10 | |
| 29. *Scruparia clavata* | | | | | x | | | | | | 1 | | | |
| 30. *Smittina trispinosa* | | | x | | x | x | | | | | 4 | | | |

* The references for the starred* numbers in the Tentacle No. column can be found under each species' descriptive section.

± The plus and minus signs in the last column mean that embryos or larvae very likely were present earlier or later than the days and months listed in the last column.

## List of Collected Algae

Chlorophyceae (green algae)

1. *Cladophora gracilis* (Griffiths) Kützing, forma *tenuis* Farlow
2. *Enteromorpha intestinalis* (Linnaeus) Link (a proliferous form)
3. *Ulva Lactuca* Linnaeus var. *rigida* (C. Agardh) LeJolis

Phaeophyceae (brown algae)

4. *Ascophyllum Mackaii* (Turner) Holmes et Batters
5. *Ascophyllum nodosum* (Linnaeus) LeJolis
6. *Chorda Filum* (Linnaeus) Lamouroux
7. *Cladostephus verticillatus* (Lightfoot) C. Agardh
8. *Desmarestia aculeata* (Linnaeus) Lamouroux
9. *Fucus evanescens* C. Agardh
10. *Fucus vesiculosus* Linnaeus
11. *Fucus vesiculosus* var. *spiralis* Farlow
12. *Laminaria Agardhii* Kjellmann
13. *Laminaria longicruris* De la Pylaie
14. *Sargassum Filipendula* C. Agardh

Rhodophyceae (red algae)

15. *Agardhiella tenera* (J. Agardh) Schmitz
16. *Callithamnion roseum* (Roth) Harvey
17. *Ceramium rubriforme* Kylin
18. *Ceramium rubrum* (Hudson) C. Agardh
19. *Champia parvula* (C. Agardh) Harvey
20. *Chondrus crispus* (Linnaeus) Stackhouse
21. *Corallina officinalis* Linnaeus
22. *Cryptopleura* sp.
23. *Cystoclonium purpureum* (Hudson) Batters var. *cirrhosum* Harvey
24. *Gracilaria confervoides* (Linnaeus) Greville
25. *Gracilaria foliifera* (Forsskål) Børgesen
26. *Lithothamnium* sp.
27. *Phycodrys rubens* (Hudson) Batters
28. *Phyllophora Brodiaei* (Turner) J. Agardh
29. *Phyllophora membranifolia* (Goodenough et Woodward) J. Agardh
30. *Plumaria scricea* (Harvey) Ruprecht
31. *Polyides rotundus* (Gmelin) Greville
32. *Polysiphonia elongata* (Hudson) Harvey
33. *Polysiphonia nigra* (Hudson) Batters
34. *Polysiphonia nigrescens* (Hudson) Greville
35. *Polysiphonia variegata* (C. Agardh) Zanardini
36. *Rhodomela subfusca* (Woodward) C. Agardh
37. *Rhodymenia palmata* (Linnaeus) Greville

Below is a list of the 30 bryozoan species which were found growing on the various algae examined by the authors.

## List of Collected Bryozoa

Entoprocta

1. *Pedicellina cernua* (Pallas) 1771

Ectoprocta

Cyclostomata or Stenolaemata

2. *Crisia eburnea* (Linnaeus) 1758
3. *Lichenopora hispida* (Fleming) 1828

Ctenostomata

4. *Aeverrillia armata* (Verrill) 1873
5. *Aeverrillia setigera* (Hincks) 1887
6. *Alcyonidium polyoum* (Hassall) 1841
7. *Bowerbankia gracilis* Leidy 1855
8. *Bowerbankia imbricata* (Adams )1800
9. *Flustrella hispida* (Fabricius) 1780

Cheilostomata

10. *Actea sica* (Couch) 1844
11. *Bugula cucullifera* Osburn 1912
12. *Bugula flabellata* (Thompson) 1848
13. *Bugula turrita* (Desor) 1848
14. *Callopora aurita* (Hincks) 1877
15. *Cellepora dichotoma* Hincks 1862
16. *Cribrilina annulata* (Fabricius) 1780
17. *Cribrilina punctata* (Hassall) 1841
18. *Cryptosula pallasiana* (Moll) 1803
19. *Electra hastingsae* Marcus 1938
20. *Electra pilosa* (Linnaeus) 1767
21. *Hippoporina contracta* (Waters) 1899
22. *Hippothoa hyalina* (Linnaeus) 1767
23. *Membranipora lacroixii* (?)
24. *Membranipora tuberculata* (Bosc) 1802
25. *Microporella ciliata* (Pallas) 1766
26. *Schizoporella biaperta* (Michelin) 1842
27. *Schizoporella unicornis* (Johnston) 1847
28. *Scruparia ambigua* (d'Orbigny) 1841
29. *Scruparia clavata* Hincks 1857
30. *Smittina trispinosa* (Johnston) 1825

## Bryozoan Growths on Algae

The bryozoa form white, grey, yellow, salmon-pink, or brown growths on the algae. Some bryozoan colonies are thin, flat, encrusting and closely adherent. Others are dendritic, arborescent, or may form a fuzzy mass of tiny vesicles. Still others coat the algae with a gelatinous, rubbery, or leathery film. The calcareous

bryozoa often retain their zooecial patterns and specific characteristics pretty well even though the algal host specimens have been dried and pressed in the normal course of herbarium sheet mounting. It was no harder to identify *Hippothoa hyalina* from a dry 1874 herbarium mount of *Phycodrys rubens* than from a freshly collected alga.

Bryozoa grow on various parts of the algal plant. The holdfast processes of Laminaria and related forms are excellent sites for attachment of at least 21 hard, horny, or soft bryozoan species. Bryozoa grow on and between the holdfast processes as well as on the rocks to which the holdfasts adhere. Laminaria and Rhodymenia blades are favorite attachment sites for *Electra pilosa* which is very common and especially abundant on these algae, sometimes coating both sides of the entire blade for an area of several inches with a thin, frosty-white, single-layered cover of contiguous bryozoan colonies. *Membranipora tuberculata* has the same habit of extensively encasing its algal hosts with the fine bryozoan mesh.

The basal or most proximal parts of *Chondrus crispus* and Phyllophora are encrusted by many bryozoans like Aeverrillia, Bowerbankia, *Cellepora dichotoma* and *Hippothoa hyalina,* while the most distal tips are somewhat less often utilized for bryozoan attachment. Sometimes, if the bryozoan growth is especially rich or dense on these two algal genera, the whole blade may be covered. Alcyonidium may encase a whole blade and sometimes extend even beyond the tips of the plant. The two Schizoporellae also may grow so readily as to produce shelf-like extensions of the colony beyond the plant thallus.

The basal parts of Ascophyllum and Fucus are generally favored by the bryozoan colonies, as are the crevices and depressions around the airbladders and where branches originate. *Flustrella hispida* and Bowerbankia particularly favor these plants.

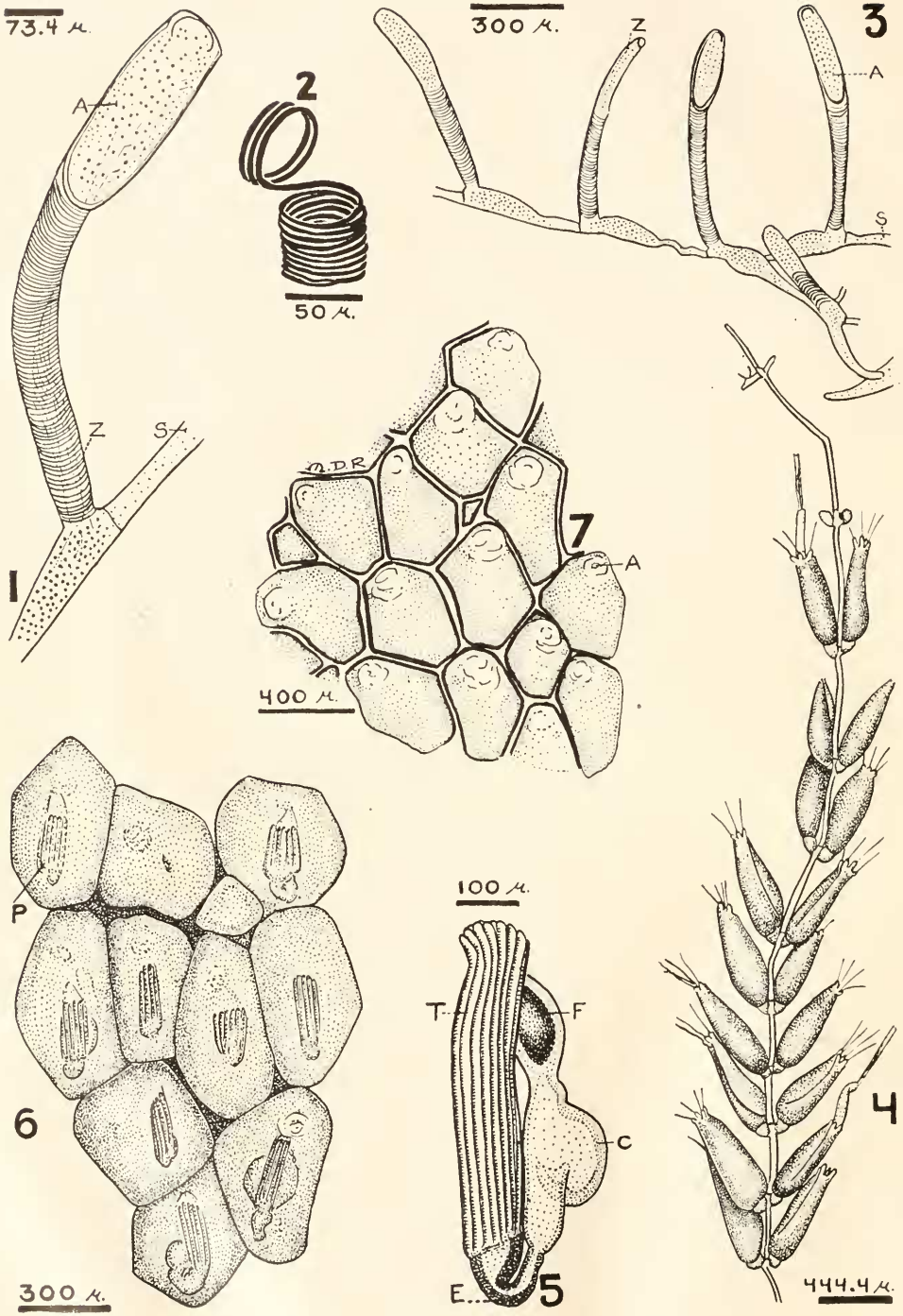
The few zoaria (bryozoan colonies) found on the green algae generally were small, consisting of only a few zoids, and did not produce such luxuriant and extensive growths as did the species which grew on the browns and reds.

The zoaria, as a rule, were one layer in thickness on the algae, with the exception of occasional specimens of *Schizoporella biaperta, S. unicornis* and *Smittina trispinosa,* which might be laminate. The laminate condition is more common on the firmer substrates (rocks) than on algae. *Hippothoa hyalina* and *Electra pilosa* were always single-layered on the plants.

Of the six most frequently encountered bryozoa (*Aetea sica, Bowerbankia gracilis* and *Crisia eburnea* each on 18 algal species, *Electra pilosa* and *Hippothoa hyalina* each on 17, and *Bugula turrita* on 16 algal species) the least conspicuous is Aetea. It readily escapes detection unless the alga is examined microscopically. Because of their very characteristic growth habit and general appearance, Electra, Bugula, Bowerbankia and Crisia can be recognized with the unaided eye. Hippothoa, with a little practice, becomes recognizable because it forms small, short, calcareous, white sheaths around the thin algal stalks and filaments. Hippothoa especially accommodates itself readily to the smallest filaments and branches.

The bryozoa occurred in close association on the same algal thallus with many other animal forms. Numerous shells of Spirorbis sp. grew alongside the *Lichenopora hispida* from Rye, N. H. Sponges, hydroids, annelid worm tubes, *Botryllus schlosseri, Molgula manhattensis,* Styela, Foraminifera, and several species of bryozoa were sometimes found on a heavily populated alga. Hydroids,

PLATE I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Foraminifera, and several bryozoan species often were found on the same blade of Ascophyllum, Chondrus, Laminaria, Phycodrys, or Phyllophora. Aeverrillia and Aetea would sometimes grow on Bugula and hydroid colonies as well as on algal thalli.

The tentacle number and the time of larval production were obtained for some species but not for all because sometimes the colonies died before they could be examined, and sometimes the organisms were so exasperatingly slow in extending their tentacles for a count. Such data as could be obtained are listed in Table IV and also in the species' descriptive section which follows.

## Aetea Sica

(Figures 1–3)

*Aetea sica* is fairly common, although not reported from this region previously. It forms a thin, white, bristly tracery on 18 different algal species. The zoids resemble fine upright tubes just big enough to be seen with the unaided eye. Slender stolons connect the bases of the upright zoids and adhere closely to the substratum (Fig. 3). Nine to eleven tentacles were counted in a few zoids. Ovicells were filled with live developing pinkish larvae from at least July 31 through August 6.

The feature by which Marcus (1937, p. 29) distinguishes *Aetea sica* from the previously reported *Aetea anguina* is the ratio of the aperture (opesium) length to opesium width. The opesial ratio for *A. anguina* is between 1.7 : 1 and 2 : 1. For *A. sica* it is between 2.6 : 1 and 4 : 1. In Figure 1, one zoid has a 4 : 1 ratio. If the ratio is a valid characteristic of the two species, then some of the previously reported *Aetea anguina* from the Woods Hole area must belong to *Aetea sica*.

---

Plate I *

Figure 1. *Aetea sica.* Upright zoid (Z) growing from a punctate stolon (S) enlargement. The opesium (A) of this zoid is about three times as long as wide (a 3 : 1 ratio). The scale above applies to this figure. Hadley Harbor specimens, VII–28–1939.

Figure 2. *Aetea sica.* Detail of a broken stalk.

Figure 3. *Aetea sica.* A colony of five zoids (Z) arising from stolons (S). The upper right zoid has an opesium (A) about four times longer than wide (4 : 1 opesial ratio). The scale above applies to this figure.

Figure 4. *Aeverrillia armata.* A sprig of a colony collected from Lagoon Pond, Martha's Vineyard, VIII–17–1945.

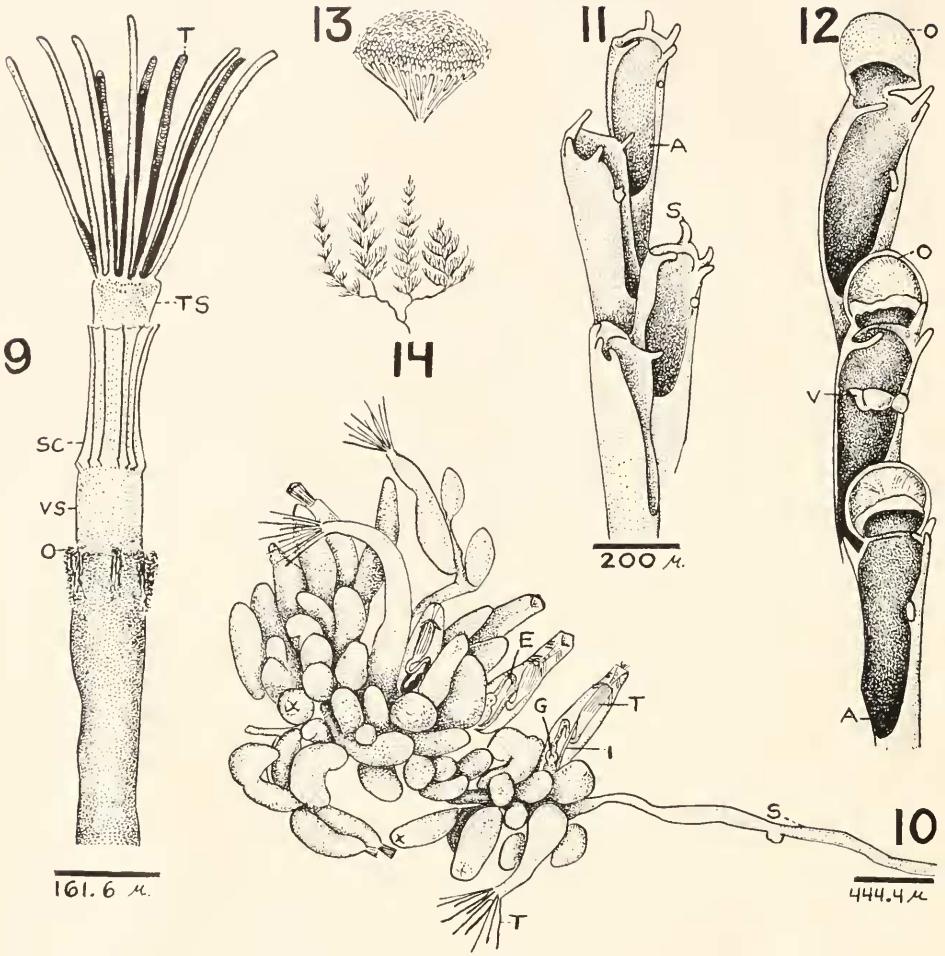
Figure 5. *Alcyonidium polyoum.* A polypide torn out of the colony, in its natural withdrawn position. It consists of tentacles (T), esophagus (E), caecum (C) and rectum which in this sketch contains a large dark fecal pellet (F). Collected off Davenport Park, New Rochelle, N. Y., on IX–22–1945.

Figure 6. *Alcyonidium polyoum.* Part of a young, fairly transparent colony most of whose zooecia contain a sketchily outlined withdrawn polypide (P). Of the same date and collecting locality as specimens of the preceding figure.

Figure 7. *Alcyonidium polyoum.* Somewhat thicker-walled colony, with slightly raised orifices (A). Collected at Black Rock, New Bedford Harbor, on VIII–8–1945.

* Figures on all plates, with the exception of Figures 13, 14 and 28, were drawn with the aid of a camera lucida. The species are alphabetically arranged except for Figure 14.

PLATE II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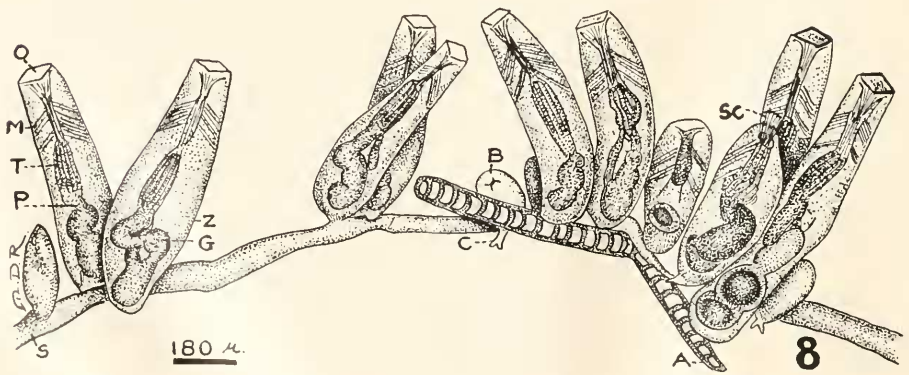
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SC
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8

### Aeverrillia Armata

(Figure 4)

*Aeverrillia armata* is transparent, yellowish, and horny, and occurs on *Laminaria Agardhii* and *Phyllophora membranifolia*. The latter alga was heavily encrusted with ten other bryozoan species and several algal species. *Aeverrillia armata* consists of numerous slender, paired autozoids arising from narrow stolons which cling closely to the plant but which can be pulled off as slender threads. This species is very similar to *A. setigera* which was discussed very fully in a previous study (Rogick, 1945a), except that it lacks the basal clasping processes of *A. setigera*. The polypides have eight tentacles in both species of the genus.

### Aeverrillia Setigera

This delicate bryozoan was found growing inconspicuously on eight algal species. It clings closely to the plant thallus. It was pictured adequately in the previous study (Rogick, 1945a), so no figure of it is here included. The resemblance between it and *A. armata* is so close that one could easily mistake the one for the other.

### Alcyonidium Polyoum

(Figures 5–7)

The various Alcyonidia are difficult to tell apart. The present *Alcyonidium polyoum* forms a firm gray or sometimes slightly yellowish crust around the hold-

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Plate II

Figure 8. *Bowerbankia gracilis*. An uncrowded stolonate colony of nine full-grown zoids (Z) and five smaller buds (B), growing on an algal filament (A). Other structures shown are: (C) caudal process; (G) gizzard; (M) parieto-vaginal musculature; (O) squared orifice; (P) polypide; (S) stolon; (SC) setigerous collar. Collection site and date same as for Figure 7.

Figure 9. *Bowerbankia imbricata*. Upper part of an extruded polypide showing ten tentacles (T) which upon retraction can be withdrawn into the tentacular sheath (TS). Around that is a stiff transparent setigerous collar (SC) which in turn can be withdrawn into the vestibular sheath (VS). Some debris has accumulated on the edge of the squared orifice (O). From Glen Island, New Rochelle, N. Y. on IX–16–1945.

Figure 10. *Bowerbankia imbricata*. A crowded colony which was scraped from *Chondrus crispus*. Collection date and site the same as for the preceding figure. Three of the long zoids have their tentacles extended. Three smaller ones have their setigerous collars partly extruded. Three zoids are shown with the polypides within them. The following parts are labelled: (E) esophagus; (G) gizzard; (I) intestine; (S) stolon; (T) tentacles.

Figure 11. *Bugula cucullifera*. Four zooecia, each provided with four spines (S). The upper three zoids show, at the side of the opesium (A), the remains of the short peduncle which had borne an avicularium. From Provincetown, Mass., on VIII–18–1947; Dr. M. Doty collector.

Figure 12. *Bugula cucullifera*. Three fertile zooecia topped with ovicells (O). The middle zooecium bears an avicularium (V), the other two have lost theirs. (A) is the opesium. The second row of zooecia which normally would be at the side of these zooecia was incomplete and was therefore not shown here. Same collection date and site and drawn to the same scale as the preceding figure.

Figure 13. *Bugula flabellata*. A freehand sketch, showing the close tuft-like mode of colony growth. About natural size.

Figure 14. *Bugula turrita*. A freehand sketch, showing the dainty, open spiral mode of colony growth. About natural size.

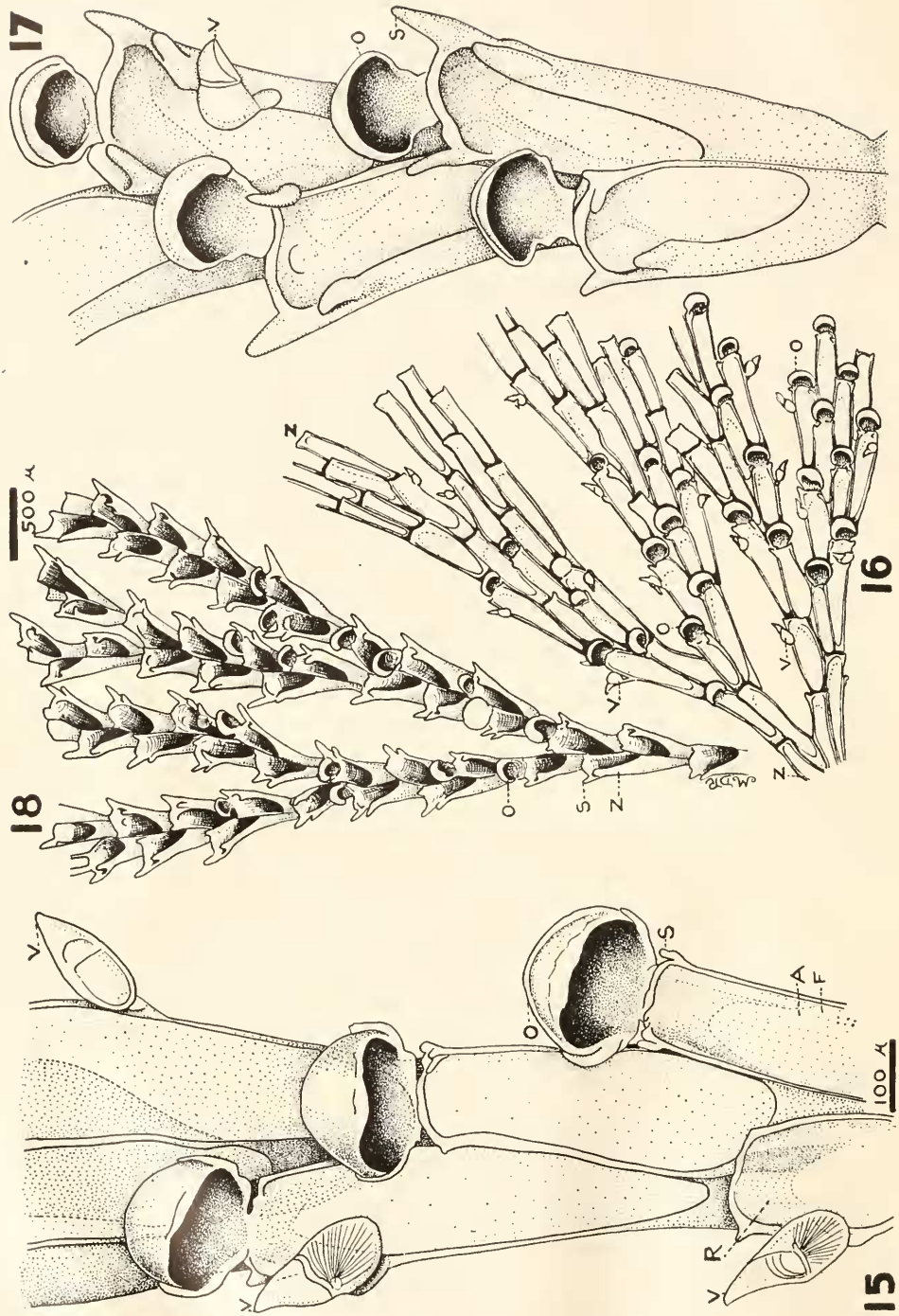


PLATE III

fasts, stalks, and blades of at least five algal species. Prenant and Teissier (1924, pp. 23, 27) reported Alcyonidium from Ascophyllum, Chondrus, Fucus, Himanthalia, *Laminaria* (*saccharina?*) and *Saccorhiza bulbosa*. Sometimes it coats the entire alga, using the various branches as cores around which to grow. The colony is rubbery to the touch.

The polypides had 16 tentacles. Measurements for 18 zoids ranged thus: zoid length 0.36–0.648 mm. and zoid width 0.24–0.504 mm. These are similar in range to figures given by Harmer (1915, pp. 37–38). The extremes in tentacle number given by various authors are 12 (Harmer, 1915, p. 38) to 20 (Silén, 1942, p. 11).

### Bowerbankia Gracilis

(Figure 8)

*Bowerbankia gracilis* is very common. It forms a soft grayish furry mass on 18 algal species. It consists of a number of transparent tubes clustered along a stolon, sometimes so densely that the stolon is scarcely visible. Caudal processes appear on some zooecia. The eight tentacles can be counted only when the animal is alive and in the expanded state. The zoids in Figure 8 are in the retracted state with the tentacles and gut (collectively called "polypide") withdrawn into the body cavity. Under such conditions the squared orifices show nicely.

### Bowerbankia Imbricata

(Figures 9–10)

*Bowerbankia imbricata* was found on only five algal species by the authors. Additional species on which it has been reported are: *Ascophyllum nodosum* (Adams, 1800, p. 11), *Corallina officinalis* (Hincks, 1880, p. 521), *Cystoseira fibrosa, Fucus serratus* (Joliet, 1877, p. 294), *Desmarestia aculeata,* and *Furcellaria fastigiata* (Thompson, 1840, p. 252). Colonies may cover extensive areas of several inches, coating the "stems" and thalli of Chondrus. They do not exclude other forms from growing on the alga but may grow among hydroids, sponges, and other encrusting forms.

Superficially, dense growths of *Bowerbankia imbricata* and *B. gracilis* are indistinguishable. Imbricata colonies whose zoids were filled with large ciliated

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Plate III

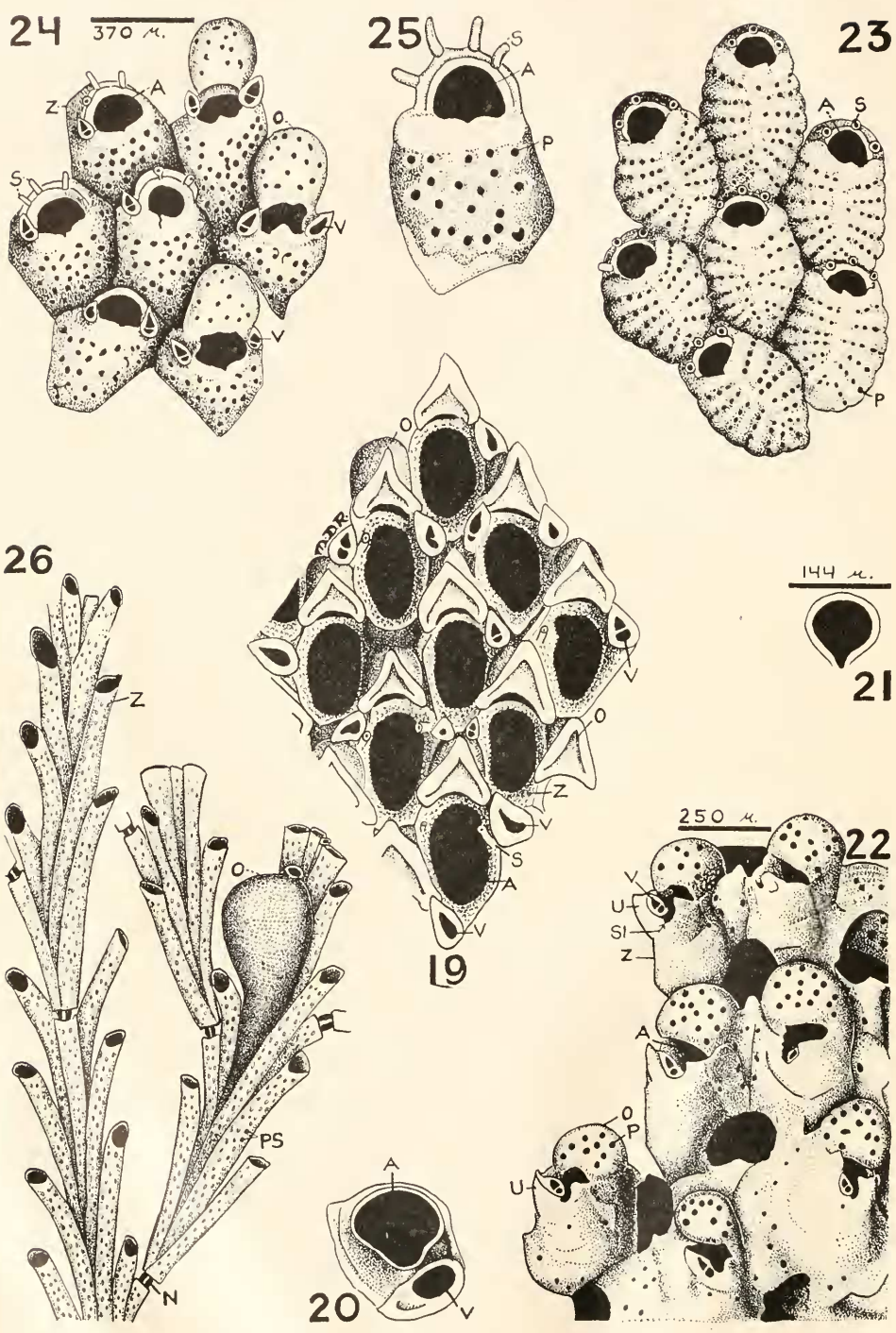
Figure 15. *Bugula flabellata*. The upper parts of three fertile ovicell-bearing zooecia (F) and an ordinary zooecium (R). Other structures shown are: (A) opesium, (O) ovicell, (S) spine, (V) avicularium. These same labels apply to the other figures on this plate.

Figure 16. *Bugula flabellata*. Broad flabellate branches with up to 6 rows of zooecia (Z) per branch. Some have ovicells, some avicularia, or both, and others have neither, at the moment. Drawn to the same scale as Figure 18.

Figure 17. *Bugula turrita*. Four fertile zooecia, each topped by a very shallow, fragile ovicell, set at an angle on the upper edge of the zooecium. Spines are well developed in this colony and one avicularium is shown. Drawn to the same scale as Figure 15. Collected at Woods Hole, VI–30–1938.

Figure 18. *Bugula turrita*. Branches showing biserial arrangement of zooecia (Z). Some zooecia bear ovicells (O).

PLATE IV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globular larvae were salmon pink in color because the red pigment of the larvae showed through the parent zoid walls. Such embryos were especially abundant in colonies collected during the first ten days in August (1947). Some embryos were found in colonies collected as late as August 31. Joliet (1877, p. 295) observed larvae during the month of July and reported that sexual reproduction took place from the end of June to early August.

Somewhat reniform larvae were released in great numbers on the morning of August 9, 1947. After a free-swimming period they attached to the substratum. Metamorphosis proceeded speedily, taking less than five minutes in some cases. The red color became concentrated at one end of the metamorphosing larva.

Adult zoids generally have ten tentacles and are square-topped when retracted. Measurements of seven retracted zoids were as follows: zoid length 0.925–1.374 mm.; zoid width 0.178–0.291 mm.; stolon diameter 0.040–0.101 mm.

Some very young colonies consisting of only one or two developing zoids had nine tentacles but their development could not be followed beyond a few days, so it could not be determined if these in time would increase their tentacular number to ten.

### Bugula Cucullifera

(Figures 11–12)

Small fragments of this Bugula were found on *Fucus evanescens* and *Rhodymenia palmata* from Vineyard Sound on VIII–1–1945, on *Laminaria longicruris* from Provincetown, Mass., on VIII–18–1947 and on *Phyllophora membranifolia,* along with much *Crisia eburnea* and *Aetea sica* from New Bedford Harbor, on VIII–8–1945.

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### Plate IV

Figure 19. *Callopora aurita.* Nine zooecia (Z) each capped by a rounded ovicell (O) which is decorated by a raised triangular ridge. Spines (S) and avicularia (V) are present near the large opesia (A). The same letters apply to the other figures on this plate. A calcined specimen from which all the soft tissues have been burned away. Drawn to the same scale as Figure 24.

Figure 20. *Cellepora dichotoma.* Part of a very lightly calcified specimen showing the shape of the aperture and the position of the avicularium. From Nobska Beach driftweed, Woods Hole, VII–25–1944. Drawn to the same scale as Figure 21.

Figure 21. *Cellepora dichotoma.* Aperture of a very young zooecium.

Figure 22. *Cellepora dichotoma.* Portion of a moderately calcified colony. An avicularium is borne on the side of the umbo (U) and faces toward a sinus (SI) in the peristome or raised shelf encircling the front of the aperture. The ovicells have pores (P).

Figure 23. *Cribrilina annulata.* Seven zooecia. Drawn to the same scale as Figure 24.

Figure 24. *Cribrilina punctata.* Seven zooecia, three of which are capped by ovicells. One or two avicularia border the wide aperture. From Penikese Island, Mass., VIII–3–1947, on *Chondrus crispus.*

Figure 25. *Cribrilina punctata.* A more heavily calcified zooecium with 4 spines above the aperture. From Gay Head, Martha's Vineyard, VII–30–1946. Drawn to same scale as Figure 21.

Figure 26. *Crisia eburnea.* Four internodes, separated by dark yellow horny joints or nodes (N), bear a number of tubular autozoids (Z). One internode bears the greatly swollen ovicell or ooecium. The zooecia have numerous pseudopores (PS). From Black Rock, New Bedford Harbor, VIII–8–1945. Drawn to same scale as Figure 24.

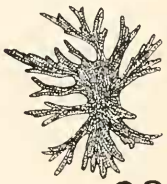
PLATE V


27


30

29

31



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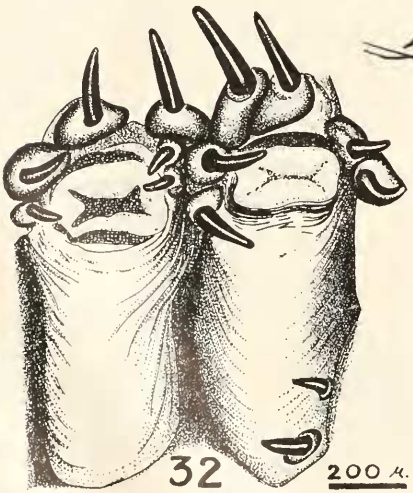


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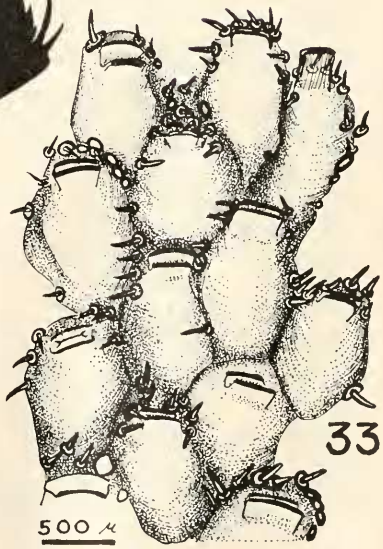


33

Some embryo-filled ovicells were present. Very long rhizoid processes grew from the basal part of some of the colonies. Thirteen tentacles were counted on one zoid.

### Bugula Flabellata

(Figures 13, 15, 16)

A small colony of *B. flabellata* was found on *Fucus vesiculosus*. It was far less common than *B. turrita*. Also, it seemed to prefer attachment to piles, live cars, and other submerged wooden objects rather than to algae. It is a very sturdy form, growing in thick, fan-shaped, yellow-orange tufts (Fig. 13) which are about a half inch tall.

Glass slides submerged in Eel Pond at Woods Hole from August 13 to August 31, 1945, were heavily overgrown with various animal forms, including *Bugula flabellata*. Colonies of the latter were by then about ¼ inch tall and contained hundreds of zoids.

According to Grave (1933, p. 384) its breeding season is between June 1 and November 15.

### Bugula Turrita

(Figures 14, 17, 18)

*Bugula turrita* is very common, growing on at least 16 algal species. In general appearance it is more plant-like than animal-like. It is of yellow-orange color and has a soft, fluffy, but firm texture. It has a beautifully spiralling manner of growth (Fig. 14). The colony branches into a number of spiralling "turrets." Some of the colonies may be 1¼ inches tall.

The tentacle number is about 14.

Ovicells were seen in colonies collected from the end of June through mid-August (Fig. 17). Many young colonies developed from released larvae during that time.

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### Plate V

Figure 27. *Electra hastingsae*. Fifteen zooecia from the central part of a colony. One zooecium has lost all the spines around its opesium. The others have retained a varying number. Calcined specimen.

Figure 28. *Electra hastingsae*. A freehand sketch showing the flat, spray-like mode of growth which is so characteristic of this species. About natural size.

Figure 29. *Electra pilosa*, long-spined form. Tip of an alga, *Desmarestia aculeata*, completely encased by a bryozoan colony some of whose zooecia show an unusually long median spine. Shown in silhouette. Collected off Gay Head, Martha's Vineyard, VII–30–1946. Drawn to the same scale as Figure 33.

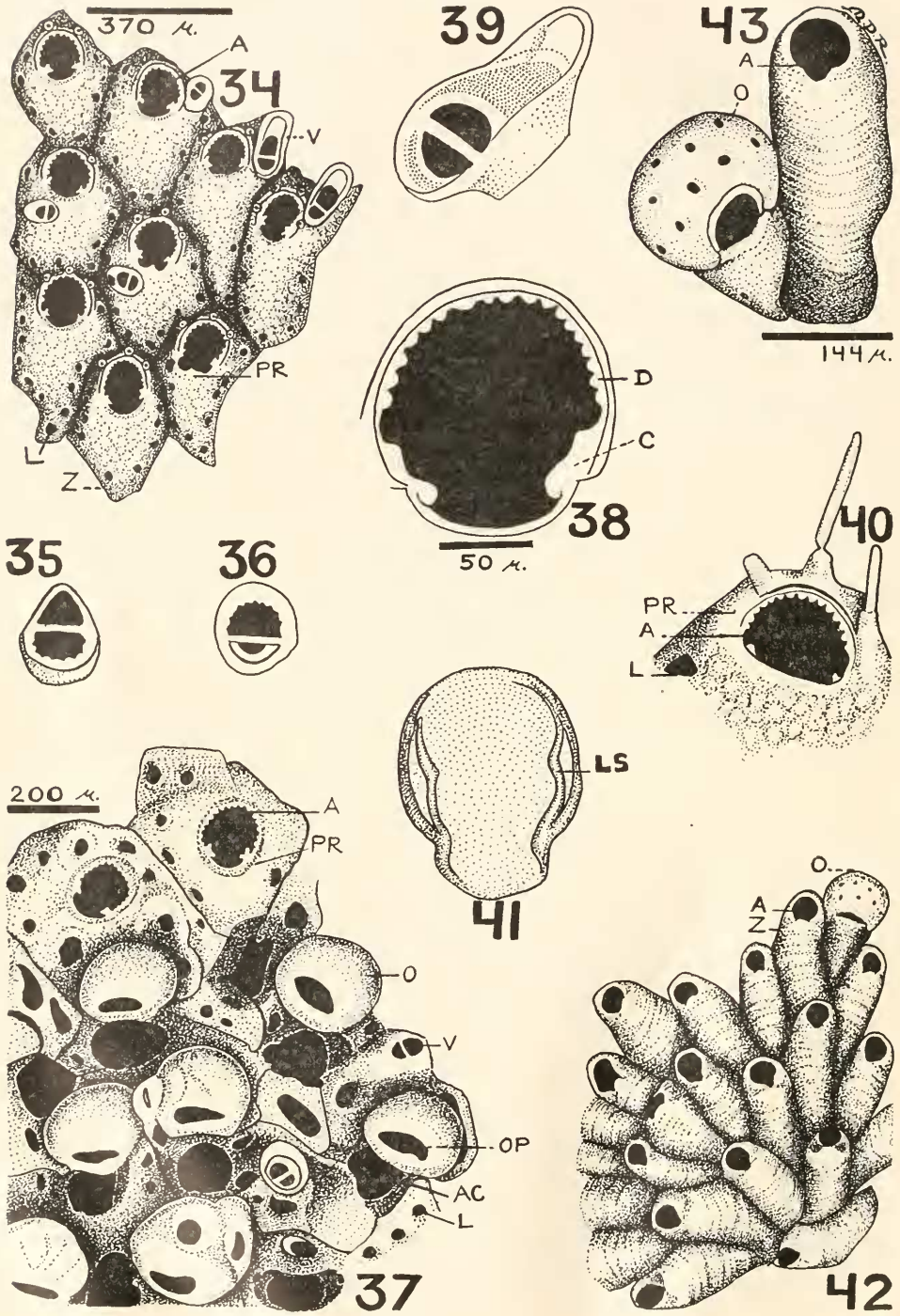
Figure 30. *Electra pilosa*, short-spined form. Four zooecia whose lowest, median spine is heavier and longer than the other opesial spines but not so long as the spines pictured in Figure 29. The two upper zoids show the crescent-shaped operculum rim in the upper part of the opesial area. The lower frontal wall of the zooecium is marked by numerous tremopores. From Devil's Foot, Woods Hole, VII–9–1945.

Figure 31. *Flustrella hispida*. A very young, spineless zoid. From Woods Hole, VIII–15–1939. Drawn to same scale as Figure 32.

Figure 32. *Flustrella hispida*. Two old zoids showing heavy "chitinization" of spines and lips of the orifice. The left zoid shows only circumoral spines while the right shows those and also additional spines located lower down on the zoid. From same colony as Figure 31.

Figure 33. *Flustrella hispida*. Twelve spine-encircled zoids from a less heavily "chitinized" part of the same colony as Figure 32.

PLATE VI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42

## Callopora Aurita

(Figure 19)

*Callopora aurita* was not abundant on algal material, being found more commonly and in more extensive patches on rocks. Very small white colonies were found on specimens of *Phycodrys rubens* collected from Rye Ledge, Rye, New Hampshire, on IX–30–1945; on *Phyllophora membranifolia* dredged from Great Harbor, Woods Hole, Mass., on VIII–8–1946, and on holdfasts of *Laminaria Agardhii*. The colonies form a fine encrusting calcareous mesh on the algal thallus.

Ovicells were present in the colonies, but it was not possible to determine whether they were tenanted by larvae at the time of collection. Twelve tentacles were counted on one zoid.

## Cellepora Dichotoma

(Figures 20–22)

Its small, white, calcareous zoaria grow on *Chondrus crispus, Gracilaria confervoides, Phyllophora Brodiaei* and *P. membranifolia*. Its zoids are crowded

### Plate VI

Figure 34. *Hippoporina contracta.* Portion of a young, uncrowded colony showing nine zooecia (Z), four of which are without avicularia (V) and three of which have a small rounded avicularium and two of which have spatulate avicularia (V). The distinctive serrate aperture (A) is readily distinguishable in these not heavily calcified zoids. The peristome (PR) is prolonged into a small bump or mucro below the aperture in the central zoid. Areolae (L) border each zooecium. The same labels apply to the other figures on this plate. Specimens dredged from Great Harbor, Woods Hole, on VIII–8–1946.

Figure 35. *Hippoporina contracta.* A small, slightly pointed avicularium with part of its aperture serrated. Drawn to same scale as Figure 43.

Figure 36. *Hippoporina contracta.* A small rounded avicularium with part of its aperture serrated. Drawn to same scale as Figure 43.

Figure 37. *Hippoporina contracta.* A more crowded and calcified colony than that of Figure 34. The upper two zoids show the typical serrate aperture. Seven ovicells (O) with large, comma-shaped pores (OP) are visible. Beneath each ovicell is a large peristomice (AC) or peristomeal opening (here shown in black), at the bottom of which lies the distinctive serrate aperture (invisible in this picture). Calcined specimen.

Figure 38. *Hippoporina contracta.* The serrate aperture characteristic of this species. The aperture, black in this calcined specimen, in life is closed over by an operculum which is pictured in Figure 41. The aperture has 14 to 18 small rounded denticles (D) and two large bifid cardelles (C).

Figure 39. *Hippoporina contracta.* A spatulate avicularium seen at an angle. Drawn to the same scale as Figure 43.

Figure 40. *Hippoporina contracta.* Upper half of a zooecium showing areola (L), denticles, cardelles, peristome (PR) and three spines above the aperture (A). Drawn to same scale as Figure 43.

Figure 41. *Hippoporina contracta.* Operculum which closes the aperture of the zooecium. It has a stiffened rim and lateral sclerites (LS). Drawn to same scale as Figure 38.

Figure 42. *Hippothoa hyalina.* A colony showing a number of ordinary zooecia (Z) and a dwarfed one topped by an ovicell (O). Drawn to same scale as Figure 34.

Figure 43. *Hippothoa hyalina.* Another view of the punctate ovicell, its dwarfed zooecium and a normal sized zooecium. The latter shows the typical aperture, rounded and with a sinus. The transverse grooving normally found in the zooecia is faintly indicated in the larger zoid. Specimens dredged off Gay Head, Martha's Vineyard, VII–30–1946.

against each other. Embryo-filled ovicells were present at the time of collection (July 25, 1944).

There is some question as to the classification of this species. *Cellepora americana, Cellepora avicularis* and *Cellepora dichotoma* show such integradation that their exact status or validity needs critical review by some future worker. The species of the present study is identical with Marcus' illustration of *C. dichotoma* (Marcus, 1938, Plate XI, Fig. 26).

The species characteristics are as follows: (1) peristome with a sinus next to a raised umbo on the side of which is an avicularium facing the sinus; (2) aperture rounded, with postral sinus; (3) ovicell with pores, rounded and somewhat flattened; and (4) a few small pores (areolae) around the frontal wall of the zooecium.

A heavily calcified zoarium may show the ovicells almost completely immersed on all sides except the frontal in the secondarily calcified zooecial wall. The frontal of such ovicells is provided with good-sized pores and is at a lower level than the secondarily calcified outer zooecial wall.

### Cribrilina Annulata

(Figure 23)

This encrusting species was very uncommon. Only one white calcareous zoarium was found on *Phycodrys rubens,* from Rye, N. H., on the reverse side of the thallus from the finer, more fragile *Cribrilina punctata.* Three or four spines were present around the aperture. Marcus (1940, p. 203) reported *C. annulata* from Laminaria.

### Cribrilina Punctata

(Figures 24–25)

Small patches of this fragile white calcareous form were found encrusting seven algal species. The number of spines around the aperture varied from none to five. The frontal pores were somewhat irregular in size and position. This was not a very common form; only a few colonies appeared in the collection.

### Crisia Eburnea

(Figure 26)

*Crisia eburnea* was exceedingly common on 18 algal species. It was especially abundant on *Chondrus crispus,* the two Phyllophorae, and *Phycodrys rubens.* A very large amount of it was collected from the driftweed along the beaches at Nobska, Gay Head, and Cuttyhunk. Dried specimens were just as useful as wet ones for taxonomic purposes.

Prenant and Teissier (1924, p. 18) reported *C. eburnea* from Halidrys and certain Cystoseiras.

It forms brittle, white, openly dendritic tufts up to 7 mm. tall on the thalli of the small, and around the holdfasts of the large, algae. A Crisia colony consists of a number of calcareous tubular zooecia forming internodes which are separated

from other internodes by short, narrow, yellowish to brown chitinous joints. A branch which consists of ordinary tubular zooecia (autozoids) alone is called a sterile internode. Three such are pictured in Figure 26. A branch which consists of a number of autozoids and a long, very swollen brood chamber (ooecium or ovicell) is called a fertile internode. One is pictured in Figure 26. In the identification of different species of Crisiidae the number of zooecia in the fertile and sterile internodes is important. In *Crisia eburnea* the sterile internode has four to eleven zooecia, and a fertile internode seven to ten (Borg, 1944, p. 158).

Ovicells were found on specimens collected throughout the summer months. Embryos were seen in some on August 8, 1946.

### Cryptosula Pallasiana

*Cryptosula pallasiana* forms a round, flat, regularly patterned, pale orange to white encrustation on rocks, shells, and algae. It occurs more commonly and forms larger colonies on the harder substrates than on the algae but is not uncommon on the latter. It was found on eleven algal species which came from a number of collecting sites between Martha's Vineyard, Woods Hole, North Falmouth, and New Bedford (all in Massachusetts). They grew on the thalli of algae and on the Laminaria holdfasts. Colonies attached to *Enteromorpha intestinalis* and *Ulva Lactuca* var. *rigida* were young and small, consisting of few (five or less) freshly formed zoids (as of VIII–13–1945). Submerged glass slides, left in Eel Pond at Woods Hole for the first two weeks in July and kept a week longer in running sea water in the laboratory, were well covered with many animal forms including *Bugula turrita, Pedicellina cernua* and *Cryptosula pallasiana*. The Cryptosula colonies had from one to thirty zoids on these slides. Their polypides had 16 tentacles.

Barrois (1877, p. 139) reported larvae in August and September. The Woods Hole specimens produced larvae in those months as well as during June and July.

Joliet (1877, p. 291) reported this bryozoan on *Callothrix pannorum*. Prenant and Teissier (1924, p. 23) reported Cryptosula from other Laminariae, Himanthalia, and *Saccorhiza bulbosa*.

No drawings of Cryptosula are here included because the species was previously figured (Rogick, 1945b, p. 3, Fig. 1).

### Electra Hastingsae

(Figures 27–28)

A few small colonies of *E. hastingsae* encrusted the thalli of *Fucus vesiculosus* var. *spiralis* and *Laminaria Agardhii*. Marcus (1938, p. 17) reported the bryozoan from Zostera. Sometimes it grows on the gill chamber of Libinia crabs. Generally, however, the bryozoan is found on hard substrates (rocks and shells) more often than on algae.

*Electra hastingsae* is a fragile, white, calcareous species, forming completely adherent frond-like traceries on the substratum (Fig. 28). Some colonies lack spines around the opesium. Other colonies have a variable number of very delicate ones, sometimes as many as 18. Some of the spines may break off (Fig. 27).

A new zooecium may occasionally grow right out of the opesium of another empty one. Whether that is a case of regeneration or the settling of a new larva on an old colony, is not certain. Embryos were not observed.

### Electra Pilosa

(Figures 29–30)

*Electra pilosa* is an extremely common calcareous but fragile encrustation on 17 algal species. It has been reported previously from: *Fucus serratus* (Joliet, 1877, p. 290); Ulva (Hutchins, 1945, p. 540); *Laminaria saccharina* (Leidy, 1855, p. 9); Furcellaria and Polyides (Marcus, 1940, p. 118); the Cystoseiras, Corallina (Prenant, 1927, p. 24) and Zostera (Prenant, 1932, p. 92).

*Electra pilosa* forms grayish-white, single-layered colonies which spread like a fine, closely-woven mesh over large areas, sometimes a foot in length, of algal thalli. Laminaria and Rhodymenia thalli are particularly favored. Numerous colonies may grow toward and into each other to form an almost continuous thin crust over the thalli. The lacy *Plumaria scricca* fronds, in some instances, were completely encased in *Electra pilosa*. Many Foraminifera were scattered over the Electra.

Great variation in degree of spination occurs. Several *E. pilosa* "forms" of dubious validity are mentioned in literature: forma *typica*, f. *dentata*, f. *laxa* and f. *verticillata*, differing slightly from each other, mainly in the presence or length of the principal median proximal spine. Borg (1930, p. 63) and others mentioned that occasionally several of these growth forms may be found in a single *E. pilosa* colony, and therefore should not be considered valid varieties.

The present writers found both long-spined (forma *verticillata*, Fig. 29) and short-spined (forma *dentata*, Fig. 30) growths in the collections, the latter being far more common than the long-spined specimens.

Tentacles numbered 12 to 14.

### Flustrella Hispida

(Figures 31–33)

*Flustrella hispida* grows on five Woods Hole algal species: *Ascophyllum nodosum, Chondrus crispus, Fucus vesiculosus, Phyllophora membranifolia* and *Ulva Lactuca* var. *rigida*. Also, the M. B. L. Collecting Crew has on numerous occasions brought in Ascophyllum covered with Flustrella from other localities. Additional algae from which it has been recorded are: *Gigantina mamillosa* (Hincks, 1880, vol. 1, p. 507); *Fucus serratus* and Cystoseira (Joliet, 1877, p. 292). It was far more common on Ascophyllum and Fucus than on the green or red algae in the Woods Hole region.

*Flustrella hispida* forms a brown, rubbery, and somewhat slimy crust over extensive areas of the algal thallus. The zoids are fairly soft and baggy (Figs. 31, 32). Thirteen tentacles were counted on one specimen. Spines were lacking in the very youngest zoids (Fig. 31), but more mature ones show variation in distribution and number of spines (Figs. 32, 33). In the oldest parts of the colony the spines may become very thick and dark reddish brown, and appear mounted on horny pads (Fig. 32) about the zooecial orifices. In younger colonies, and also in some older zooecia, as in the right zoid of Figure 32, spines appear elsewhere about the zoid than just around the orifice. The reinforced orifices are shaped like the top of a purse (Figs. 32, 33).

Barrois (1877, p. 214) found *F. hispida* colonies filled with embryos during the months of May, June and July.

### Hippoporina Contracta

(Figures 34–41)

White to buff-colored colonies of this species were found more often on rocks and shells than on algae. However, some did grow on *Phyllophora Brodiaei* and *P. membranifolia,* and were up to 2 cm. in diameter. The appearance of the colony varies greatly, depending upon the age of the colony, degree of calcification, the presence of ovicells and the nature of the substratum (compare Figs. 34 and 37).

The key character in identifying this species is the "beaded" aperture (Fig. 38) whose circular outline, serrate antral border, and two bifid cardelles marking the postral border vary so little that they can be identified in either old or young colonies. The number of rounded denticles in the antral border ranges from 14 to 18. In old, heavily calcified colonies (Fig. 37), the zooecial wall and peristome around the aperture may increase in thickness so greatly that the primary "beaded" aperture comes to lie considerably below the external body wall surface, at the bottom of a calcareous "well," the wall of which is formed by the peristome. The top opening of this calcareous "well" is called either the secondary aperture or the peristomice (Fig. 37, AC).

In younger, less calcified colonies, two to six oral spines, sometimes measuring 0.12–0.13 mm., may appear on the peristome (Fig. 40). These break off and their bases may become completely overgrown in the process of increasing calcification of the body wall.

Marcus reported 12 tentacles for this species (1937, p. 98).

The ovicells are quite characteristic also. They are smooth, hemispherical, and provided with a large, comma-shaped membranous area or pore (Fig. 37, OP) on the frontal surface.

Six to thirteen marginal pores or areolae (Fig. 34, L) can be seen in the zooecial body wall.

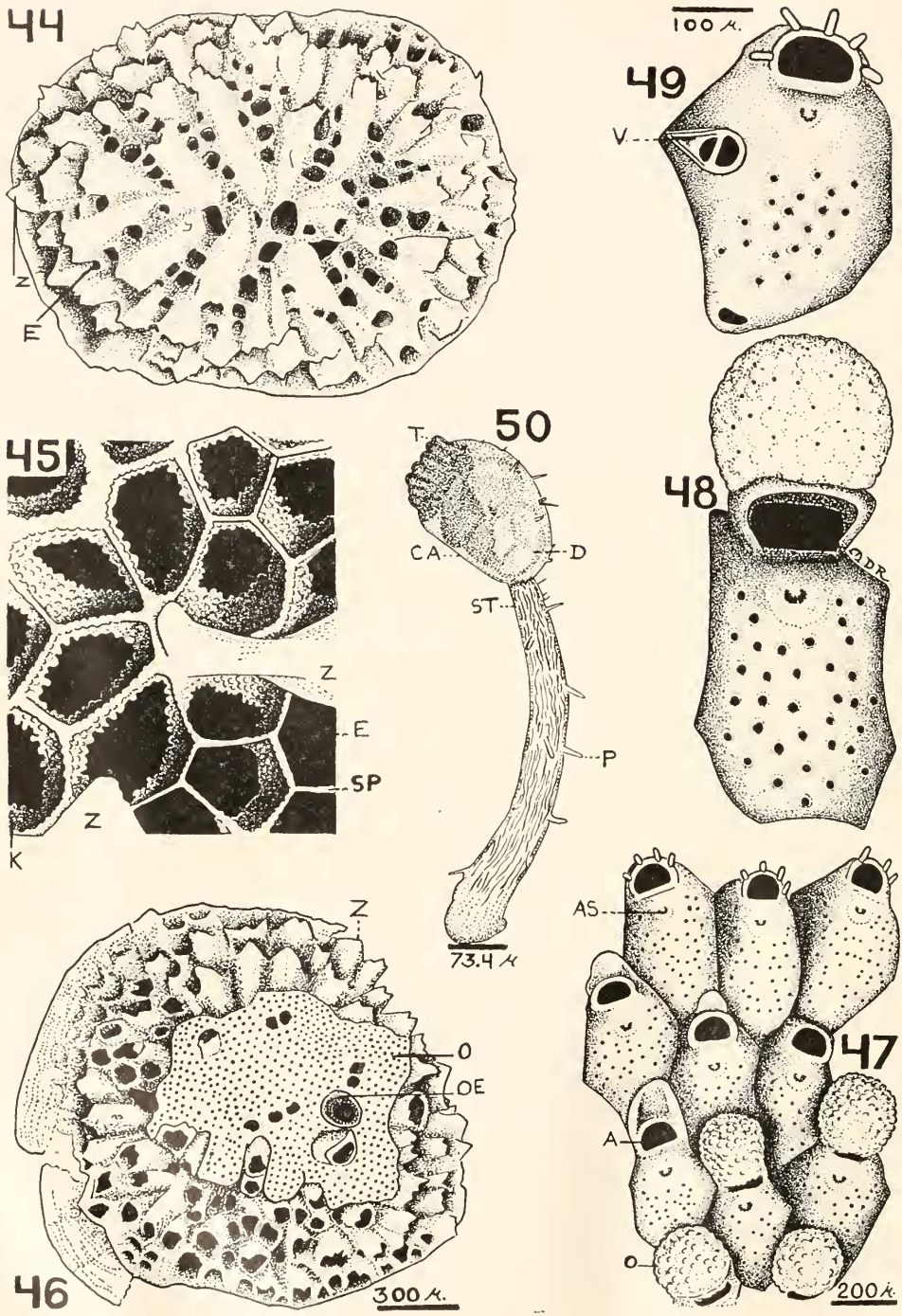
### Hippothoa Hyalina

(Figures 42–43)

*Hippothoa hyalina* was extremely common on 17 algal species in the Woods Hole region. Borg (1930, p. 84) listed it from *Laminaria saccharina;* Prenant and Teissier (1924, p. 22) from the Florideae and Dictyota, and Prenant (1927, pp. 26–27) from *Laminaria cloustoni* and *Saccorhiza bulbosa.* A dry herbarium mount of a pressed *Phycodrys rubens* (collected by Dudley at Marble Head in Sept. 1874) was examined by the writers and found to contain easily recognizable and uncrushed *H. hyalina* zoaria.

*Hippothoa hyalina* forms glistening white or grey calcareous patches usually from 1 to 8 mm. in diameter, either on or encircling the thalli of most of the mentioned algae and on the holdfasts of Laminaria and Rhodymenia. "Stems" or filaments of *Cystoclonium purpureum* var. *cirrhosum* were encased in rough

PLATE VII


44
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MDK
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calcareous sheaths of *H. hyalina* sometimes an inch in length. Often the sheaths of colonies were arranged in a linear series, the total series attaining a length of several inches.

Embryo-filled ovicells were plentiful in specimens collected during July and August in the Woods Hole area. Many ancestrulae or the single individuals from which a colony begins were observed in collections made up to August 11, 1945. These ancestrulae arise from sexually produced larvae. Barrois (1877, p. 164) remarked that at Roskoff the embryos were carried in transparent ovicells in the months of May and June, so apparently the breeding season is of considerable length.

### Lichenopora Hispida

(Figures 44–46)

One fertile and less than a dozen small immature colonies of this species were found growing on *Phycodrys rubens* and *Phyllophora membranifolia* collected from Rye, N.H. on IX–30–1945.

The fertile colony (Fig. 46) has a brood chamber provided with a thin, rounded aperture and many small pores. The autozoids (Fig. 44) terminate in jagged edges. They are partly surrounded by reticulate alveoli (Fig. 45) which are lined with small calcareous projections from the interalveolar septa whose thickness is variable.

Borg (1926) gives a good account of the development of various Cyclostomata, including the Lichenoporae, and discusses the terminology of the group.

### Membranipora Lacroixii (?)

*Membranipora lacroixii* is a species whose identification and synonymy are exasperatingly confused in literature. Part of this is due to vague original

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Plate VII

Figure 44. *Lichenopora hispida.* A fairly young colony showing autozooecia (Z) separated by large cavities or alveoli (E). Drawn to same scale as Figure 46.

Figure 45. *Lichenopora hispida.* Detail of the center of an immature though fair-sized colony, showing about 17 alveolar spaces (E), the interalveolar septa (SP) between them and the projections (K) from the calcareous cryptocyst of the septal wall. The sides of two autozoids (Z). Drawn to same scale as Figure 49.

Figure 46. *Lichenopora hispida.* A damaged, fertile colony, showing an irregular, punctate brood chamber (O), the brood chamber aperture (OE) and numerous short (immature or damaged?) and some normal autozoids (Z).

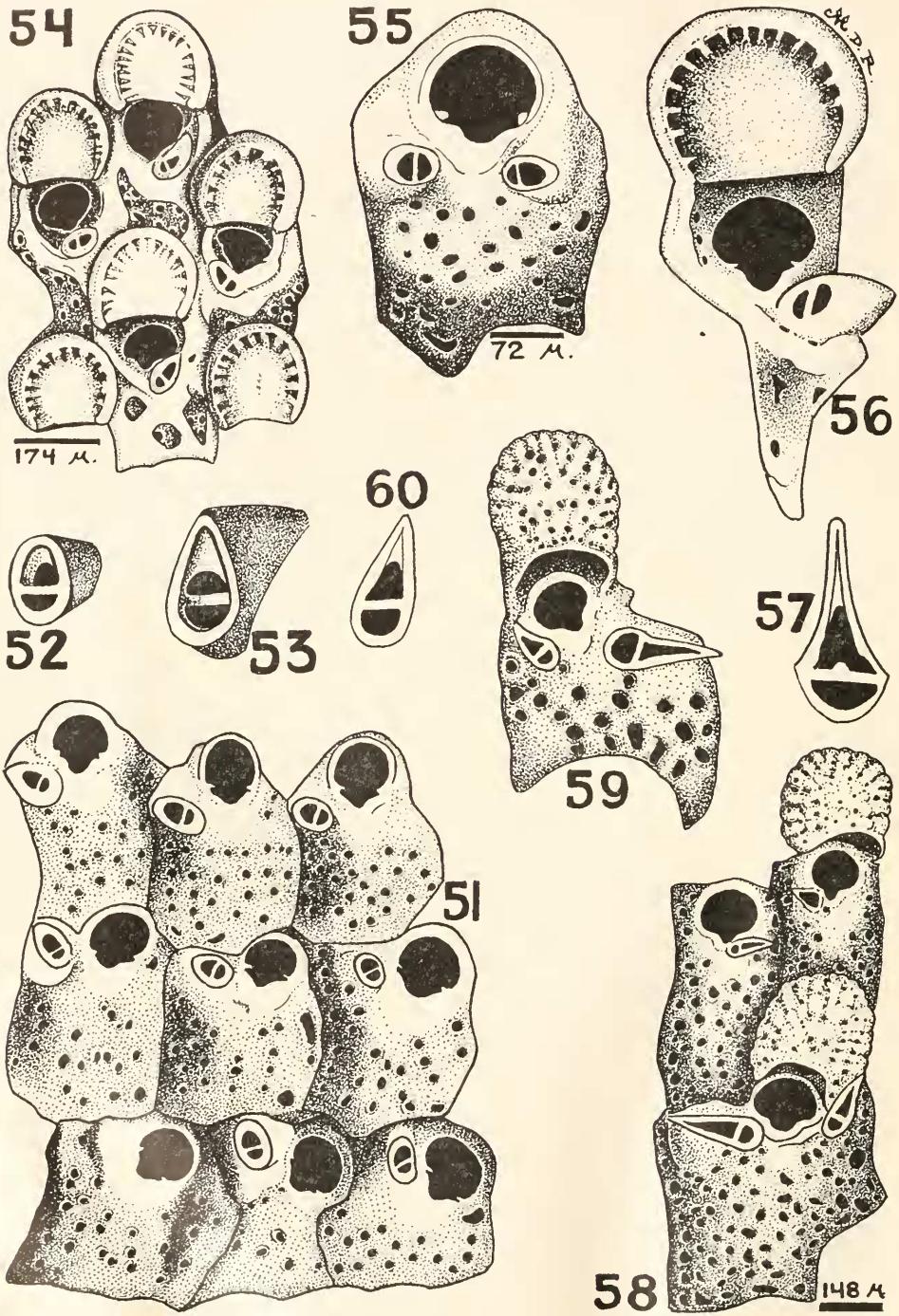
Figure 47. *Microporella ciliata.* Nine zooecia, four of which have well-developed ovicells (O) and three of which have shelf-like beginnings of ovicells distal to the aperture (A). Each zooecium has a crescent-shaped ascopore (AS) and smaller frontal pores. Oral spines occur on the upper three zoids. The crescent-shaped ascopore and the hemispherical aperture are key characters for this species.

Figure 48. *Microporella ciliata.* A zooecium topped by an ovicell. Both have pores but of different size. Drawn to same scale as Figure 49.

Figure 49. *Microporella ciliata.* A zooecium showing oral spines and a pointed avicularium (V) in a characteristic position. The avicularium may develop on either the right or left side of the zoid. Same collection area and date as Figure 43.

Figure 50. *Pedicellina cernua.* A single zoid consisting of a stalk (ST) and a calyx (CA) containing the polypide (D) and rolled in tentacles (T). A few spines (P) occur on the stalk and calyx. From Black Rock, New Bedford Harbor, VIII–8–1945.

PLATE VIII



descriptions, and part due to the apparently great variation in spination and degree of calcification of the zooecia. Such will continue to be the state of affairs until someone takes the trouble to make a very elaborate study of the variations of this species. The Woods Hole and New Rochelle specimens of the present study resemble the *Membranipora lacroixii* pictured by Osburn (1912, Plate 22, Fig. 22), the *Conopeum lacroixii* pictured by Canu and Bassler (1920, Plate 13, Fig. 9), the *Conopeum reticulum* pictured by Harmer (1926, Plate 13, Fig. 12), the *Biflustra aciculata* of MacGillivray (1891, Plate 9, Fig. 5) and the *Membranipora crustulenta* of Osburn (1944, Fig. 20, p. 32). Our specimens differ from the *Conopeum reticulum* pictured by Marcus (1938, Plate 2, Fig. 5A), the *Conopeum lacroixii* figured by Canu and Bassler (1923, Plate 29, Fig. 4), the *Membranipora reticulum* f. *lacroixii* and *M. crustulenta* of Borg (1930, pp. 63–65). The present study specimens definitely are not the *M. crustulenta* of Borg because that species is pictured with a calcified operculum, a character not present in our specimens. Until the status and limits of the species are fixed, the present authors will continue to call it *M. lacroixii,* as in Osburn's 1912 paper.

*Membranipora lacroixii* was found encrusting rocks, shells, and less frequently the algae *Ascophyllum Mackaii, Chondrus crispus* and *Phyllophora membranifolia.* It formed a delicate, gray-white tracery which adhered so closely to the substratum, especially rocks, that it was difficult to dislodge. No avicularia or ovicells were found. The conspicuous triangular spaces mentioned as characteristic by Harmer and Marcus were not observed on our specimens. Calcifica-

PLATE VIII

FIGURE 51. *Schizoporella biaperta.* Nine regularly arranged, moderately calcified zooecia, one of which is without an avicularium. Drawn to the same scale as Figure 54. Calcined specimen.

FIGURE 52. *Schizoporella biaperta.* A small ellipsoidal avicularium. Drawn to same scale as Figure 55.

FIGURE 53. *Schizoporella biaperta.* A small oval or somewhat pointed avicularium. Drawn to same scale as Figure 55.

FIGURE 54. *Schizoporella biaperta.* A fertile area of a colony showing six ovicells. The middle ovicell is most nearly typical in appearance. The frontal area of its zooecium is more highly calcified than that of the other three zooecia above it, and than that of the zooecia of Figure 51.

FIGURE 55. *Schizoporella biaperta.* A moderately calcified zooecium showing two avicularia, the two apertural teeth (cardelles) and the sinus between them. A typical specimen.

FIGURE 56. *Schizoporella biaperta.* A heavily calcified zooecium topped by an ovicell. The zooecial shape is atypical and due to crowding in the colony and to excessive calcification. The avicularium is heavily calcified. The depressed rim of the ovicell frontal has been accidentally over-emphasized and should look less depressed (see Figure 54, middle ovicell). Drawn to same scale as Figure 55.

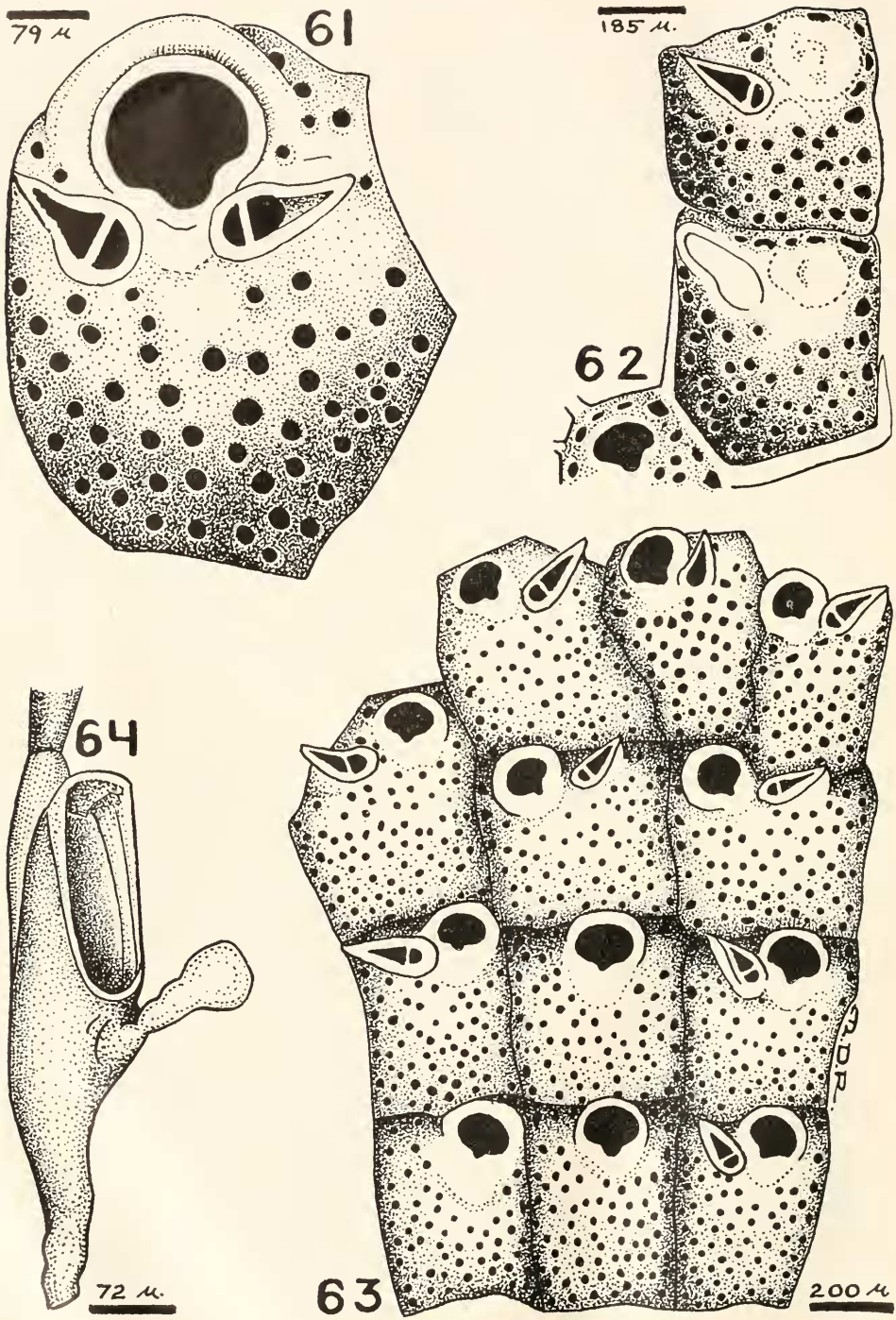
FIGURE 57. *Schizoporella unicornis.* A sharply pointed avicularium. Drawn to same scale as Figure 55.

FIGURE 58. *Schizoporella unicornis.* Three zooecia, two of which have ovicells. The bottom zooecium is twice as broad as the other two to which it gives rise. The zooecial frontal wall and the ovicells have pores. The sharply pointed avicularia vary in size and are near the aperture.

FIGURE 59. *Schizoporella unicornis.* Another unusually shaped and very broad zooecium which would give rise to two rows of zoids. The pores of its frontal area and of the ovicell are better shown. Drawn to the same scale as Figure 54.

FIGURE 60. *Schizoporella unicornis.* A smaller pointed avicularium, drawn to the same scale as Figures 55 and 57.

PLATE IX



tion was not heavy. Some New Rochelle specimens had up to ten spines, while others had no spines around the aperture—all in the same colony. Some zoids had 11 tentacles.

This species was pictured in an earlier paper (Rogick, 1940, p. 167, Figs. 6–9).

### Membranipora Tuberculata

A specimen of *Membranipora tuberculata* was found on fronds of Cryptopleura sp. and Sargassum sp. which were sent to the writers by Dr. William Randolph Taylor. The Cryptopleura had come from Puerto de la Paloma, Uruguay, from the collection of Carmen de Franco de Pimienta. The Sargassum sp. had been collected by Adrien Questel on April 21, 1944, from Guadeloupe, Antilles. This Membraniporan has been previously reported by Marcus from Laminaria (1939, p. 126) and Fucus (1937, p. 34); by Hastings (1929, p. 706) from Padina; and by Osburn (1912, p. 231) from *Sargassum bacciferum* which had drifted into Vineyard Sound.

The extensive colonies of *M. tuberculata* spread flatly over the algal fronds in an ivory-white lacework, reminiscent of *Electra pilosa*. The two or three prominent calcareous tubercles at the anterior end of each zooecium from which this species gets its name may project separately and distally or may coalesce, forming a somewhat rounded ledge.

Since *M. tuberculata* was adequately pictured in both Osburn's (1912, as *M. tchuelca*) and Marcus' (1937) papers, no figure of it was included in the present study.

### Microporella Ciliata

(Figures 47–49)

Small, flat, circular colonies, white to irridescent in color, calcareous though fragile, encrust shells, rocks, and five algal species in the Woods Hole region. Prenant and Teissier (1924, p. 23) found *Microporella ciliata* on three additional algae: Himanthalia, *Laminaria saccharina* and *Saccorhiza bulbosa*. Hadley Harbor specimens were found growing on the same thallus with Foraminifera, *Aetea sica, Crisia eburnea, Hippothoa hyalina,* and *Schizoporella biaperta*.

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### Plate IX

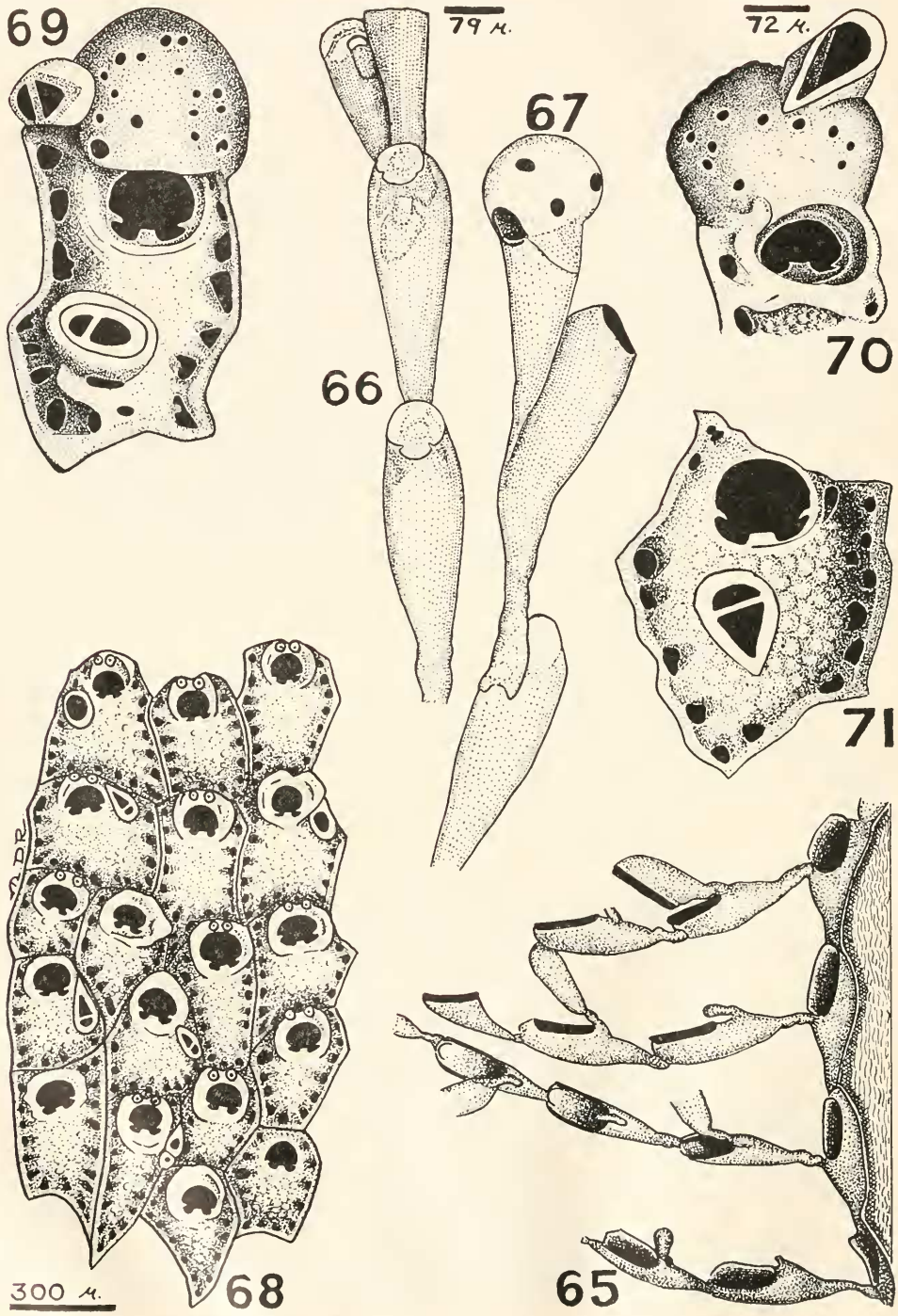
Figure 61. *Schizoporella unicornis*. A single zoid showing typical rounded aperture with its postral sinus and two pointed avicularia situated on either side of the aperture. The presence of two avicularia is a less frequent condition than the presence of one avicularium. Frontal surface of zooecium has a number of closely set pores. Calcined specimen.

Figure 62. *Schizoporella unicornis*. Three zooecia showing varying degrees of calcification. The uppermost square zooecium has a completely calcified aperture. The second squared zooecium has the aperture and avicularium openings completely calcified or plugged up. Around the right, left and lower sides of this second zoid are white septa, outgrowths from a newly overgrowing colony whose marginal zooecium is shown as the partial, third, bottom zooecium with black aperture.

Figure 63. *Schizoporella unicornis*. Portion of a typical colony. Three rows of zooecia are at the bottom and four at the top of this colony fragment, showing how a colony may increase in width at the periphery. Five zooecia have the avicularium on one side of the aperture, four on the other and three are without avicularia. Apertures may be placed either in the middle or at one side of the distal part of the frontal surface. The frontal surface is rather flat in this colony. Calcined specimen.

Figure 64. *Scruparia ambigua*. A zoid with a frontal and distal bud. The basal proximal part of the frontal bud and of the zoid is slightly twisted, a typical condition.

PLATE X



Some zooecia are without oral spines, avicularia or ovicells. Others have them. Oral spines may number from 3 to 7 (Figs. 47, 49). Ovicells are globose, "pebbled" in texture, and provided with small pores (Fig. 48). One avicularium is placed at an angle on either the right or the left frontal side, one-third to one-half of the way down and laterad from the aperture. The aperture is hemispherical and placed above the small crescent-shaped ascopore (Fig. 49). Canu and Bassler (1930, p. 47) reported 13 to 14 tentacles for this species.

Embryo-filled ovicells were collected on VIII–28–1939. Many very young colonies were found developing at that time also.

## Pedicellina Cernua

(Figure 50)

*Pedicellina cernua* though small, soft-bodied, and inconspicuous was reported on 11 algal species. Also, Leidy (1855, p. 11) reported it on the "roots" of *Laminaria saccharina;* Prenant and Teissier (1924, p. 19) reported it on the Cystoseiras, Florideae and Dictyota; and Joliet (1877, p. 296) on *Corallina squammata* and *Cladophora rupestris.*

It has a creeping stolon from which arise flexible stalked zoids. Spines occurred on the calyx and stalk (Fig. 50) of a few zoids but most specimens were without them. The tentacle number in several very young zoids was 8 to 12. The number increases with age. Marcus (1939, p. 212) gives the tentacle range for this species as 8 to 24.

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## Plate X

Figure 65. *Scruparia ambigua.* A row of four zooecia encrusting a thick algal filament. From these arise four branches of zoids. The opesial rim of all but possibly the terminal budless individuals is parallel to the back of its own zoid. Drawn to the same scale as Figure 68.

Figure 66. *Scruparia clavata.* Two full-grown zooecia and two developing buds. The smaller, left bud belongs to a developing ovicell. The ovicelled individual originates below the other bud. Drawn to the scale above.

Figure 67. *Scruparia clavata.* Two grown zooecia and a third smaller one topped by a globose ovicell which has several large pores. The ovicell faces in the opposite direction from the ordinary zooecium. Drawn to same scale as Figure 66.

Figure 68. *Smittina trispinosa.* Eighteen ordinary zooecia growing in a very regular fashion. Some zooecia have rounded and some pointed avicularia while others have none at all. The flared peristome about the aperture is well developed in many. Some have spines, others do not. Calcined specimen.

Figure 69. *Smittina trispinosa.* A zooecium, ovicell and two avicularia. The circular aperture with the two cardelles (lateral teeth) and the lyrula (broader, median tooth) is a key character. So are the ovicell with its pores and leaning avicularium and the row of marginal zooecial areolae. Avicularia may be found in various locations on the frontal zooecial surface (compare this figure with Figures 68 and 71). The zooecium shows secondary calcification about the lower avicularium and partly covering the lower areolae. Drawn to same scale as Figure 70. Calcined specimen.

Figure 70. *Smittina trispinosa.* An ovicell topped by a triangular avicularium. The zooecial peristome is heavily calcified and forms a collar at the bottom of which can be seen the aperture, lyrula and cardelle.

Figure 71. *Smittina trispinosa.* A young zoid showing the characteristic apertural features and a frontal triangular or pointed avicularium. The frontal surface is slightly "beaded" and marginal areolae outline the thin edge. Drawn to same scale as Figure 70.

### Schizoporella Biaperta

(Figures 51–56)

This white to reddish-orange bryozoan is fairly common on nine algal species. Its colonies attain a diameter of 2 cm. or more and appear fairly sturdy. They grow either flat on the thallus or may extend beyond the thallus, forming calcareous "ruffles" which may be lamellate (several layers in thickness).

The key characters of this species are: (1) rounded aperture with a postral sinus between the two cardelles (Fig. 55); (2) one or two small oval or ellipsoidal avicularia (Figs. 52, 53) mounted on mammillate prominences at the right or left or both sides of the sinus area (Figs. 51, 55); (3) frontal wall perforated by irregularly sized and spaced pores, and (4) hemispherical ovicells the edge of whose frontal area is slightly depressed and marked by faint calcareous ribs (Figs. 54, 56). Heavy calcification obscures some of these characters, especially the porous frontal area of the zooecium (Figs. 54, 56).

Twelve tentacles were counted on one zoid.

In July and August, the ovicells contained red embryos or larvae.

### Schizoporella Unicornis

(Figures 57–63)

*Schizoporella unicornis* is very common on rocks and shells, but less frequent on algae. It grew on six Woods Hole region algal species. Additional algal hosts mentioned by Prenant and Teissier (1924, p. 23) are the Florideae, Himanthalia, and *Saccorhiza bulbosa.*

There is great variation in the appearance of the colonies. Their color ranges from white to reddish orange to a dull red. Some are smooth, flat, and shining, others rough and extended beyond the thalli. They may be lamellate, one colony growing over another. No description of the species is necessary because Figures 58 and 59 show the ovicells, and Figures 61 and 63 show the typical zooecial appearance, growth habit, aperture shape, and disposition of the avicularia. The avicularia grade in size (Figs. 57–60), but are always sharply pointed. Calcification may sometimes obliterate them and the aperture (Fig. 62).

In the Woods Hole area, larvae were found in ovicells in July and August (the times when collection was made) and undoubtedly occurred before and beyond these dates. At Beaufort, North Carolina, they are found the year round, according to McDougall. McDougall (1943, p. 340) observed that the times of greatest abundance of larvae (as judged by settlings on experimental substrata there at Beaufort) were in May, June, September, October and November.

### Scruparia Ambigua

(Figures 64–65)

Most of the specimens of this dainty little dendritic form were dredged off Gay Head, Martha's Vineyard, on VII–30–1946. Some were growing on *Bugula turrita,* others on eleven algal species. It also grew in close association with hydroids and *Hippothoa hyalina.*

*Scruparia ambigua* zoids are yellowish, horny, transparent, and slender. They ranged from 0.345 to 0.495 mm. in length, the average of 12 specimens being 0.431 mm. The branching of the colony is quite open. Tentacles numbered ten in each of two zoids. No ovicells or larvae were found in the present material. Barrois (1877, p. 194) found ovicells and larvae at Roskoff during the month of June.

Hastings (1941) made a careful study of this species and differentiated *Scruparia ambigua* from *S. chelata* on the basis of the opesial slant and encrusting zooecia. In *S. ambigua* the opesial rim is parallel to the basal wall of the zooecium, and the free zooecial branches arise from a series of encrusting zooecia, as in Figure 65.

### Scruparia Clavata

(Figures 66–67)

A few scraps of this delicate, horny, dendritic, transparent bryozoan were growing on *Laminaria Agardhii* which was dredged off Gay Head, Martha's Vineyard on VII–30–1946. Some ovicells were present. The zooecia bearing them were slightly smaller (Fig. 67) than the other zooecia. The zooecial orifice is much smaller than that of *Scruparia ambigua.*

Marcus (1940, p. 208) created a new genus *Haplota* for *S. clavata.*

### Smittina Trispinosa

(Figures 68–71)

This species was found with great frequency on shells and rocks, sometimes many layers in thickness on the latter. However, its occurrence on algae was infrequent. *Chondrus crispus* (from North Falmouth, Mass.), *Laminaria Agardhii, Phyllophora Brodiaei,* and *P. membranifolia* from Woods Hole had a few colonies.

Rock colonies or nodules often are a light mustard yellow color; colonies on algae, however, were never that striking a color, but were ivory or iridescent.

Colonies are very fine grained in general appearance. The species shows a great deal of variation, depending upon age, degree of calcification, and nature of the substratum.

### Summary

1. A total of 30 bryozoan species was reported from 37 species of marine algae.

2. Five bryozoan species were reported from three species of green algae, 26 bryozoan species from 11 species of brown algae, and 27 bryozoan species from 23 species of red algae.

3. *Phyllophora membranifolia* yielded the greatest number of bryozoan species (23), *Chondrus crispus* and *Laminaria Agardhii* each yielded 20, *Phyllophora Brodiaei,* 15, and *Cystoclonium purpureum cirrhosum* yielded 11 bryozoan species.

4. Each of the three commonest bryozoa, *Aetea sica, Bowerbankia gracilis* and *Crisia eburnea,* was found on 18 algal species.

5. Each of the two next commonest bryozoa, *Electra pilosa* and *Hippothoa hyalina,* occurred on 17 red and brown algal species.

6. *Bugula turrita,* the next most common form, was found on 16 algal species.

7. *Crisia eburnea* and *Hippothoa hyalina* were common on over half the red algal species examined.

8. Some bryozoa seemed to grow most frequently and abundantly on certain algal species, namely:

a. *Alcyonidium polyoum* on *Chondrus crispus, Phyllophora Brodiaei,* and *P. membranifolia*
b. *Bowerbankia gracilis* on *Ascophyllum nodosum, Chondrus crispus, Fucus vesiculosus, F. vesiculosus spiralis, Phyllophora Brodiaei* and *P. membranifolia*
c. *Crisia eburnea* on *Chondrus crispus, Phyllophora Brodiaei* and *P. membranifolia*
d. *Electra pilosa* on *Laminaria Agardhii* and *Rhodymenia palmata*
e. *Flustrella hispida* on *Ascophyllum nodosum.*

9. To the 84 known Woods Hole region bryozoan species can be added three more: *Aetea sica, Cellepora dichotoma* and *Scruparia ambigua.* It is quite possible that some of the previously reported *Aetea anguina* and *Cellepora americana* material may have included *Aetea sica* and *Cellepora dichotoma,* respectively.

10. Algal collections from New Rochelle, N. Y., yielded some of the same bryozoan species as are found in Woods Hole, namely: *Alcyonidium polyoum, Bowerbankia imbricata, Cryptosula pallasiana, Electra hastingsae, Membranipora lacroixii*(?), and *Pedicellina cernua.*

11. Algal collections from Rye, N. H., yielded some of the same bryozoa as are found at Woods Hole, namely: *Callopora aurita, Cribrilina annulata, Cribrilina punctata, Crisia eburnea, Electra pilosa, Hippothoa hyalina* and also a form, *Lichenopora hispida,* which did not occur at Woods Hole.

12. Twenty-six of the thirty bryozoan species were carefully illustrated.

13. Tentacle number counts were made for 15 species.

14. Three bryozoan species were collected, observed, or known to be in the larva-producing stage on algae in late June; seven species in July; ten in August; two in September. These were chance observations and the number of species would have been greater if more exhaustive collections over a greater number of months could have been made.

## LITERATURE CITED

Adams, J., 1800. II. Descriptions of some marine animals found on the coast of Wales by the late John Adams, Esq. *Trans. Linn. Soc.,* **5**: 7–13.

Barrois, J., 1877. Recherches sur l'embryologie des bryozoaires. Six-Horemans, Lille.

Borg, F., 1926. Studies on recent cyclostomatous bryozoa. *Zool. Bidrag från Uppsala,* **10**: 181–507.

Borg, F., 1930. Moostierchen oder Bryozoen (Ectoprocten). *Die Tierwelt Deutschlands, Teil* **17**: 24–142.

Borg, F., 1944. The stenolaematous bryozoa. *Further Results Swed. Antarct. Exped. 1901–1903,* 3 (5): 1–276. Stockholm.

Canu, F., and R. Bassler, 1920. North American early tertiary bryozoa. *Smithsonian Institution, U. S. Nat. Mus. Bull.,* **106**: 1–879. Text vol.

Canu, F., and R. Bassler, 1923. North American later tertiary and quaternary bryozoa. *Smithsonian Institution, U. S. Nat. Mus. Bull.,* **125**: 1–302.

Canu, F., and R. Bassler, 1930. Bryozoaires marins de Tunisie. *Station Oceanogr. de Salammbô, Annales,* No. **5**: 1–92. July.

Grave, B. H., 1933. Rate of growth, age at sexual maturity and duration of life of certain sessile organisms at Woods Hole, Mass. *Biol. Bull.*, **65**: 375–386.

Harmer, S. F., 1915. The polyzoa of the Siboga expedition, Part I. The Entoprocta, Ctenostomata and Cyclostomata. *Siboga-Expeditie, Monogr. 28a,* Livr. **75**: 1–180.

Harmer, S. F., 1926. The polyzoa of the Siboga expedition, Part II. Cheilostomata Anasca. *Siboga-Expeditie, Monogr. 28b,* Livr. **105**.

Hastings, A. B., 1929. Cheilostomatous polyzoa from the vicinity of the Panama Canal, collected by Dr. C. Crossland. . . . *Proc. Zool. Soc. London,* Feb. 13, 1930, No. **47**, Part **4**: 697–740.

Hastings, A. B., 1941. The British species of Scruparia (polyzoa). *Ann. Mag. Nat. Hist.,* ser. 11, **7**: 465–472.

Hincks, T., 1880. A history of the British marine polyzoa. Vol. **1**, Text, pp. 1–601; Vol. **2**, Plates. John van Voorst, London.

Hutchins, L. W., 1945. An annotated check-list of the salt-water bryozoa of Long Island Sound. *Trans. Conn. Acad. Arts and Sci.*, **36**: 533–551.

Joliet, L., 1877. Contributions à l'histoire naturelle des bryozoaires des côtes de France. *Arch. de Zool. Exper. et gen.*, **6**: 193–304.

Leidy, J., 1855. Contributions towards a knowledge of the invertebrate fauna of the coasts of Rhode Island and New Jersey. *Jour. Acad. Nat. Sci.*, Phila., Ser. 2, **3**: 3–20. Plates X, XI.

Macgillivray, P. H., 1891. Art. XIII. Descriptions of new or little-known polyzoa, Part XIV. *Proc. Royal Soc. of Victoria, N. S.*, **3**: 77–83.

Marcus, E., 1937. Bryozoarios marinhos brasileiros, I. *Univ. São Paulo, Bol. Fac. Philos., Sci. e Letr., I, Zoologia,* No. **1**: 5–224.

Marcus, E., 1938. Bryozoarios marinhos brasileiros, II. *Univ. São Paulo, Bol. Fac. Philos., Sci. e Letr., IV, Zool.*, **2**: 1–196.

Marcus, E., 1939. Briozoarios marinhos brasileiros, III. *Univ. São Paulo, Bol. Fac. Filos., Cienc. e Letr., XIII, Zool.*, **3**: 111–354.

Marcus, E., 1940. Mosdyr (Bryozoa eller Polyzoa). Danmarks Fauna. Dansk Naturhistorisk Forening. København.

McDougall, K. D., 1943. Sessile marine invertebrates at Beaufort, North Carolina. *Ecol. Monogr.*, **13**: 321–374.

Osburn, R. C., 1912. The bryozoa of the Woods Hole region. *Bull. Bur. Fish.*, **30** (760): 205–266.

Osburn, R. C., 1944. A survey of the bryozoa of Chesapeake Bay. *Publ. No. 63, Chesapeake Biol. Lab., Dept. of Research and Educ., State of Md., Bd. of Nat. Resources.* 59 pp.

Prenant, M., and G. Teissier, 1924. Notes éthologiques sur la faune marine sessile des environs de Roscoff. *Trav. de la Stat. Biol. de Roscoff*, 30 Avril, Fasc. **2**: 1–49.

Prénant, M., 1927. Notes éthologiques sur la faune marine sessile des environs de Roscoff, II. *Trav. de la Stat. Biol. de Roscoff,* 30 Sept., Fasc. **6**: 1–58.

Prenant, M., 1932. Étude de bionomie intercotidiale la Baie et la Pointe de Quiberon. *Trav. Stat. Biol. Roscoff,* **10**: 37–103.

Rogick, M. D., 1940. An ecological effect of the New England hurricane. *Ohio Jour. Sci.*, **40**: 163–167.

Rogick, M. D., 1945a. Studies on marine bryozoa, I. Aeverrillia setigera (Hincks) 1887. *Biol. Bull.*, **89**: 201–214.

Rogick, M. D., 1945b. "Calcining" specimens. *Amer. Biol. Tchr.*, **8**: 66–70.

Rogick, M. D., 1948. Studies on marine bryozoa, II. Barentsia laxa Kirkpatrick 1890. *Biol. Bull.*, **94**: 128–142.

Silén, L., 1942. Carnosa and Stolonifera (bryozoa) collected by Prof. Dr. Sixten Bok's Expedit. . . . *Arkiv för Zool.*, **34A**: 1–33.

Taylor, W. R., 1937. Marine algae of the Northeastern coast of North America. Univ. of Mich. Press, Ann Arbor, Mich.

Thompson, W., 1840. No. 31 of the volume. Art. XXVIII, Additions to the fauna of Ireland. *Ann. Mag. Nat. Hist.*, ser. 1, **5**: 245–257.